April 1988
NSRP 0295

NATIONAL SHIPBUILDING RESEARCH PROGRAM

Development of Standard Procedures for Shipboard Print Inspection

U.S. DEPARTMENT OF TRANSPORTATION
Maritime Administration
in cooperation with
National Steel and Shipbuilding Company
San Diego, California

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U.S. Department
of Transportation

Maritime
Administration

400 Seventh Street, S.W.
Washington, D.C. 20590

June 23, 1989

Mr. L.P. Haumschilt
NSRP Program Manager
Natianal Steel and Shipbuilding Co.
Harbar Drive and 28th Street
San Diego, CA 92138

Dear Lyn:

Under Department of Transportation Reimbursable Agreement No. 400-47006, David Taylor Naval Ship Research and Development Center (now David Taylar Research Center) agreed to perform a study of "Marine Coating Performance for Different Ship Areas - Phase II." While this project was a part of the National Shipbuilding Research Program of which Panel 023-1 (now SP-3) had cognizance, contractual arrangements were made directly between MARAD and the Navy as a matter of convenience.

I am pleased to inform you that this project has been completed. Two copies of Report DTRC/SME-88-l7, "Development of Standard Procedures for Shipboard Paint Inspection" are enclosed for your use. I would appreciate your making arrangements to have this report issued as a part of the NSRP series and distributed appropriately.

Sincerely,

V.W. RINEHART
Senior Advisor far Shipbuilding

Enclosures

David Taylor Research Center

Bethesda, MD 20084-5000

DTRC/SME-88-17 **September 1988**

Ship Materials Engineering Department

Test and Evaluation

Development of Standard Procedures for Shipboard Paint Inspection

by

Thomas Radakovich

MAJOR DTRC TECHNICAL COMPONENTS

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The use of protective coatings is a common method of corrosion control in the marine industry. To ensure that these coatings remain intact and effective, they must be inspected periodically so that damaged areas are discovered and repaired. Currently there are no widely accepted standard methods for shipboard inspection of anti-corrosive coating systems.

Therefore, the Navy, the Maritime Administration, and the shipbuilding industry co-sponsored a program directed at standardizing the methods used for shipboard inspection of coating systems and for reporting inspection data. The output of this program was the development of four inspection standards for different ship areas. These four standards have been adopted by the American Society for Testing and Materials (ASTM) as ASTM standards. This report discusses the development of these inspection standards.

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ABSTRACT

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ADMINISTRATIVE INFORMATION

This work was accomplished under a program jointly sponsored by the Navy, the Maritime Administration, and the shipbuilding industry. The project manager is Virgil Rhinehart (Maritime Administration). The work was performed by the David Taylor Research Center (DTRC), Code 2841, under the direction of Jean Montemarano, Branch Head.

BACKGROUND

Protective coatings are a commonly used means of controlling corrosion in the marine industry. These coatings are applied to corrosion-Prone substrates such as the steel hull of a ship. The coatings perform their anticorrosion function simply by providing a barrier between the substrate and the corrosive

saltwater environment. To ensure that these anticorrosive coatings remain intact and effective as barriers between substrate" and environment, they must be inspected periodically so that damaged areas are discovered and repaired.

Currently there is no widely accepted standard method for shipboard inspection of anticorrosive coating systems. As a result, nearly every organization that inspects ships uses different inspection and reporting methods. Furthermore, individual inspectors within the same organization often use different methods and criteria when inspecting and reporting. Consequently, inspection reports have formats ranging from detailed reports with quantitative, numerical data to very general reports with narrative data.

The practice of using widely-differing, nonstandard inspection and reporting methods results in several problems. First, narrative reports often are a matter of individual interpretation. When an inspector reports that a tank "was severely corroded," a reader of the report does not know the actual extent of the corrosion or what the inspector considers "severe corrosion." Second, numerical data, such as the percent of area covered by corrosion or blistering, is obtained by different methods and therefore is often inaccurate and not reproducible. Finally, correlation of data from several inspections over a period of time is nearly impossible when the inspection reports are not standard. To solve these problems, the Navy, the Maritime Administration, and the shipbuilding industry cosponsored a program directed at standardizing the methods used for shipboard inspection of coating systems and for

reporting inspection data.

After the inspection and reporting procedures were developed, the Navy began inspecting submarine main ballast tanks using the inspection and reporting procedures developed for tanks and voids. As a result of this experience, the Navy changed the standard form considerably to reflect its own needs. This evolution of inspection and reporting methods for paint systems aboard ships is discussed in this report.

DEVELOPMENT OF STANDARD INSPECTION PROCEDURES

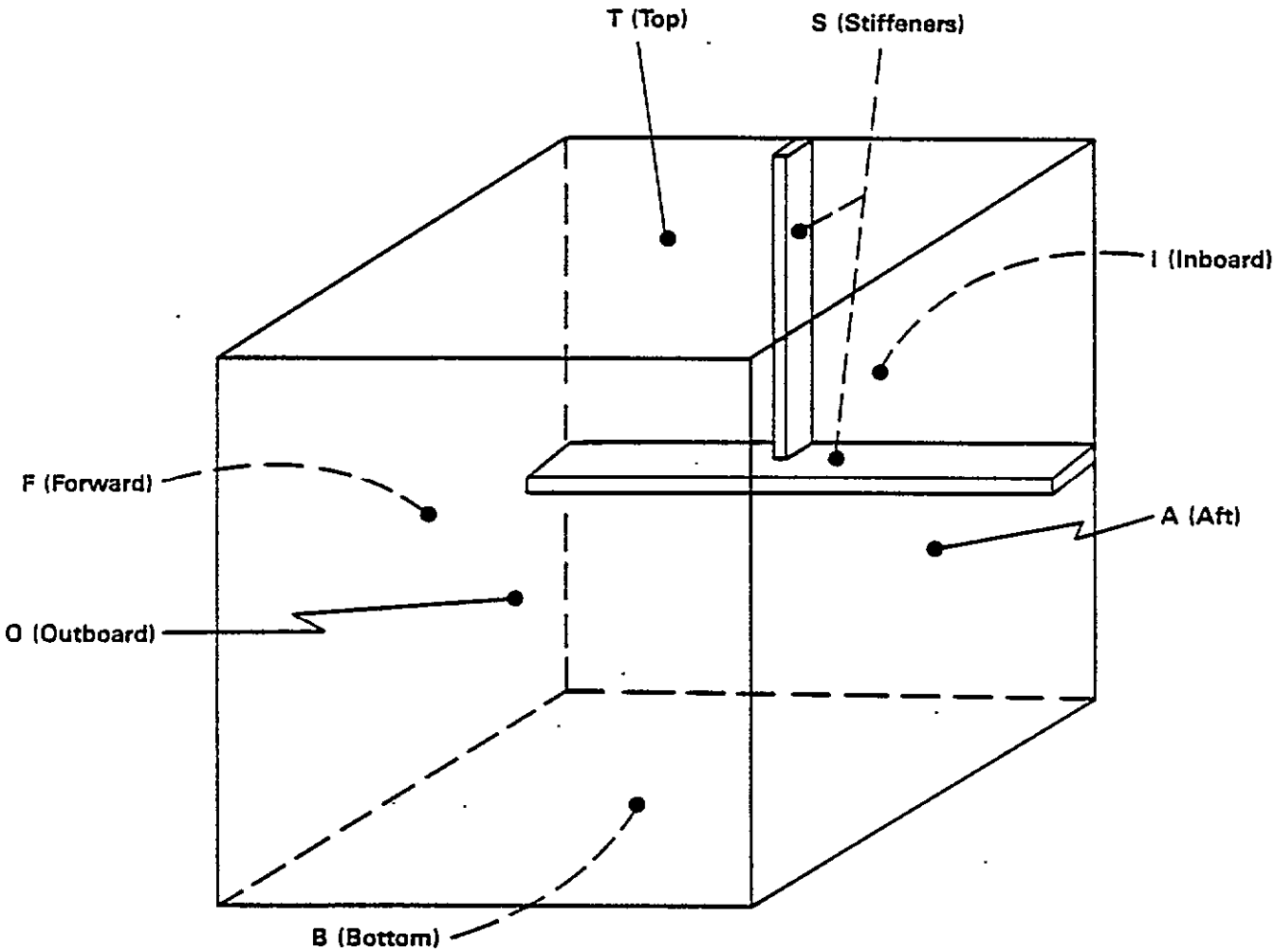
The objective of this program was to develop standard inspection and reporting procedures for use when inspecting the tanks and voids as well as all exterior areas of a surface ship during drydocking. Accomplishing this objective required that the ship be divided into four component areas, each component area having its own separate inspection procedure and report form. The four component areas are:

1. underwater hull and boottop,
2. topside and superstructure,
3. decks and deck machinery, and
4. tanks and voids.

All four component areas have several common elements which the inspector must address, such as reporting the extent of corrosion, the extent of blistering of the coating, and the measurement of the dry film thickness. However, the component areas also have individual inspection elements which are unique to only one or two of the areas. For example, the inspector

may find barnacles, tubeworms, and other fouling organisms on the underwater hull area but not in the other areas. Likewise, the effect of cat: :dic protection, which is commonly used in tanks, is not a consideration in some areas. Such individual inspection elements required that four separate inspection procedures and reports forms be developed.

Several noteworthy features have been incorporated into the inspection procedures to enhance accuracy, reproducibility, and ease of inspection. One such feature is the partitioning of the component areas into smaller, more manageable inspection areas. For example, the individual inspection areas for tanks and voids are illustrated in Fig. 1. There are seven individual inspection areas -- FORWARD, AFT, INBOARD, OUTBOARD, TOP$_t$ BOTTOM, and STIFFENERS. Each area is inspected-separately with the data being recorded on separate report forms. A complete tank inspection is the composite of seven individual inspection reports. Dividing the total area into smaller parts facilitates both accuracy and ease of inspection. Suppose, for example, that you were interested in approximating the percentage of the total area in a tank which had corrosion present. It is difficult to look at an area of 5000 square feet or more, distributed over several surfaces in three planes and to generate one" accurate percentage number. It would be easier and more accurate to approximate the Percentage in smaller individual areas and to then calculate the overall percentage from the individual approximations. Also, this method of inspecting smaller areas allows the inspector to pin-point problem areas. For example, tanks frequently retain a layer of water on the bottom which



F — Forward - Closest to Bow
A — Aft - Closest to Stern
I — Inboard - Closest to and Parallel to Midline
O — Outboard - Outermost and Parallel to Midline
T — Top
B — Bottom
S — Stiffeners

Fig. 1. Individual inspection areas for tanks and voids.

cannot be drained. The “BOTTOM” area, therefore, is probably more prone to corrosion than other areas of the tank. Similarly, the vapor” space in the top of the tank can cause special corrosion problems. Inspection of individual areas allows verification of these possibilities.

Another important tool is the use of pattern-matching to approximate percentage of a total area. Probably the most significant data gathered during a shipboard coating inspection is the percentage of a ship area which shows coating failure. For example, knowing if the percentage of a tank covered by corrosion is 1% or 10% is important. However, approximating these Percentages accurately by "eyeballing’s is very difficult. A visual method which has proven to yield more accurate and reproducible results than ‘eyeballing"is pattern-matching. The pattern-matching approach was first applied to ship inspections by International Paint Company.[1] The International Paint Company methods were modified somewhat at the recommendation of Navy, NACE-certified paint inspectors. The recommendations were made after the International method was used to inspect the hull of a Navy ship. The resulting method involves using two sets .of standard area diagrams to match the pattern of coating damage in an inspection area. To illustrate the method by example, assume the diagram below (Fig. 2) represents an entire inspection area and that the blackened areas represent corrosion.

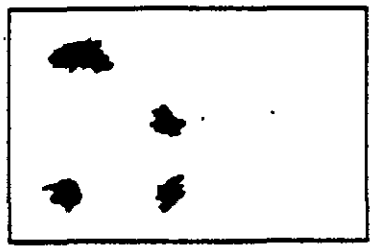
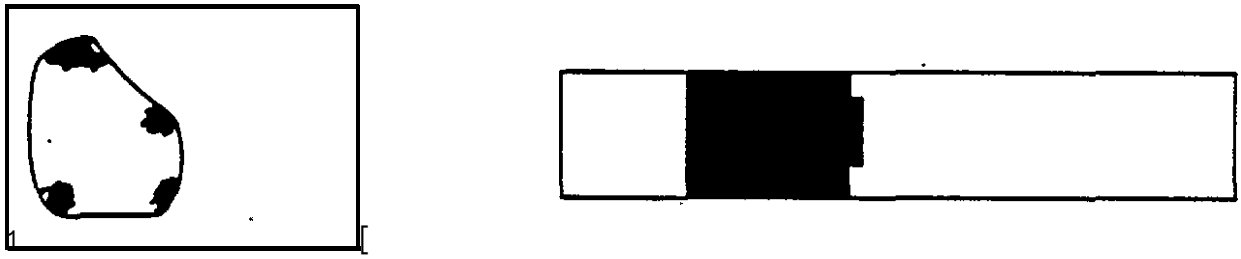


Fig. 2. Sample inspection area for pattern-matching. Black areas represent corrosion.'

The first step is to draw an imaginary line enclosing all of the corrosion areas, as shown in Fig. 3a. This enclosure should be as small as possible.. Next, select the diagram from the "Overall Extent Diagrams" shown in Fig. 4 whose area most closely resembles the enclosed area in relation to the entire inspection area. In this case, the enclosed (shaded) area most closely matches Diagram 6 as seen in Fig. 3b.



(a) Enclosed Area (b) Diagram 6

Fig. 3. Using the Overall Extent Diagrams of Fig. 4 to estimate extent of corrosion.

The second step is to look only at the enclosed area and select the diagram from the "Extent Within Affected Area" diagrams shown in.Fig. 5 (2 pages) which most closely identifies the pattern of corrosion patches within the enclosed area. In the corrosion example of Fig. 2, Diagram N would be a good choice, as shown in Fig. 6.

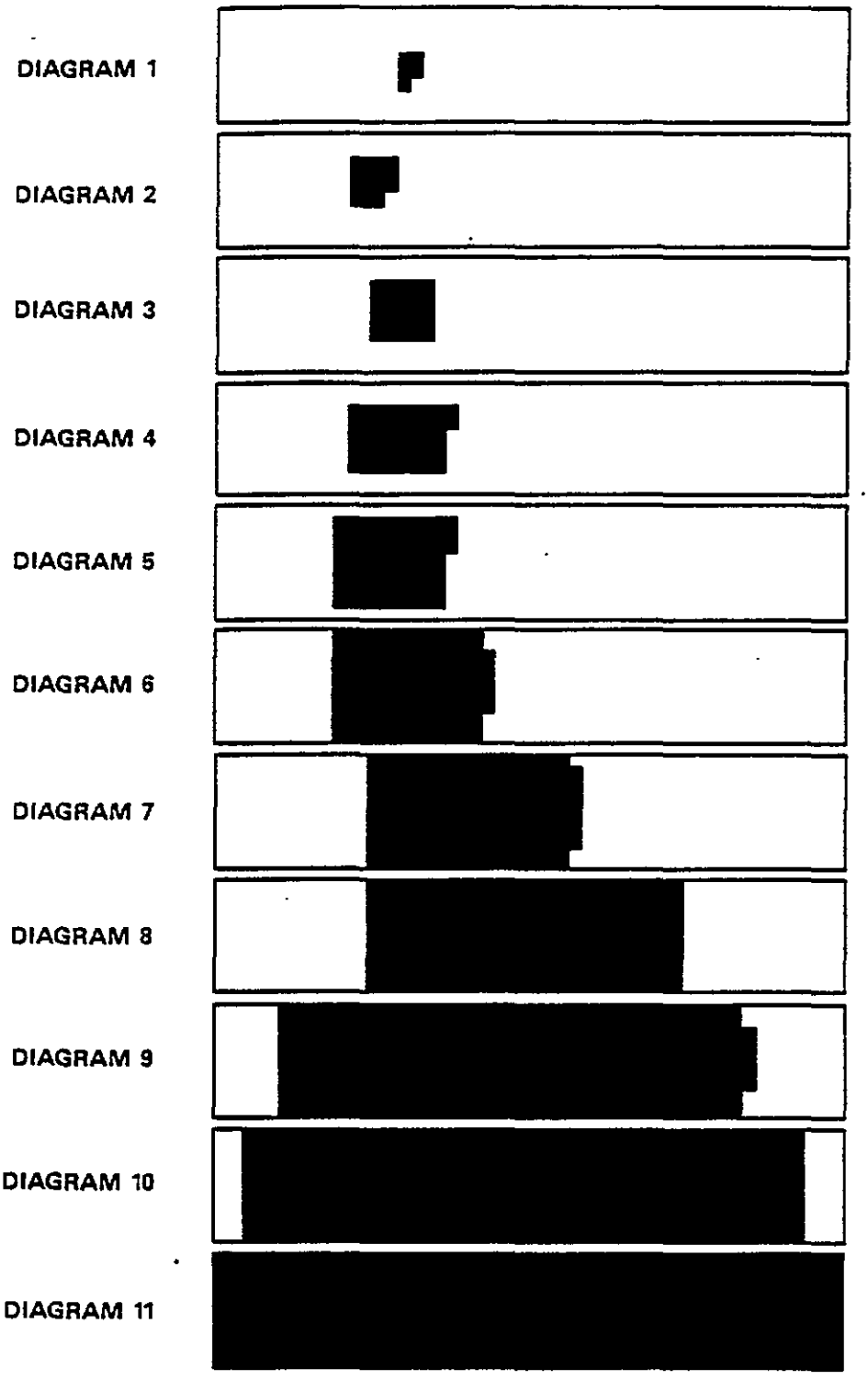


Fig. 4. Overall extent diagrams.

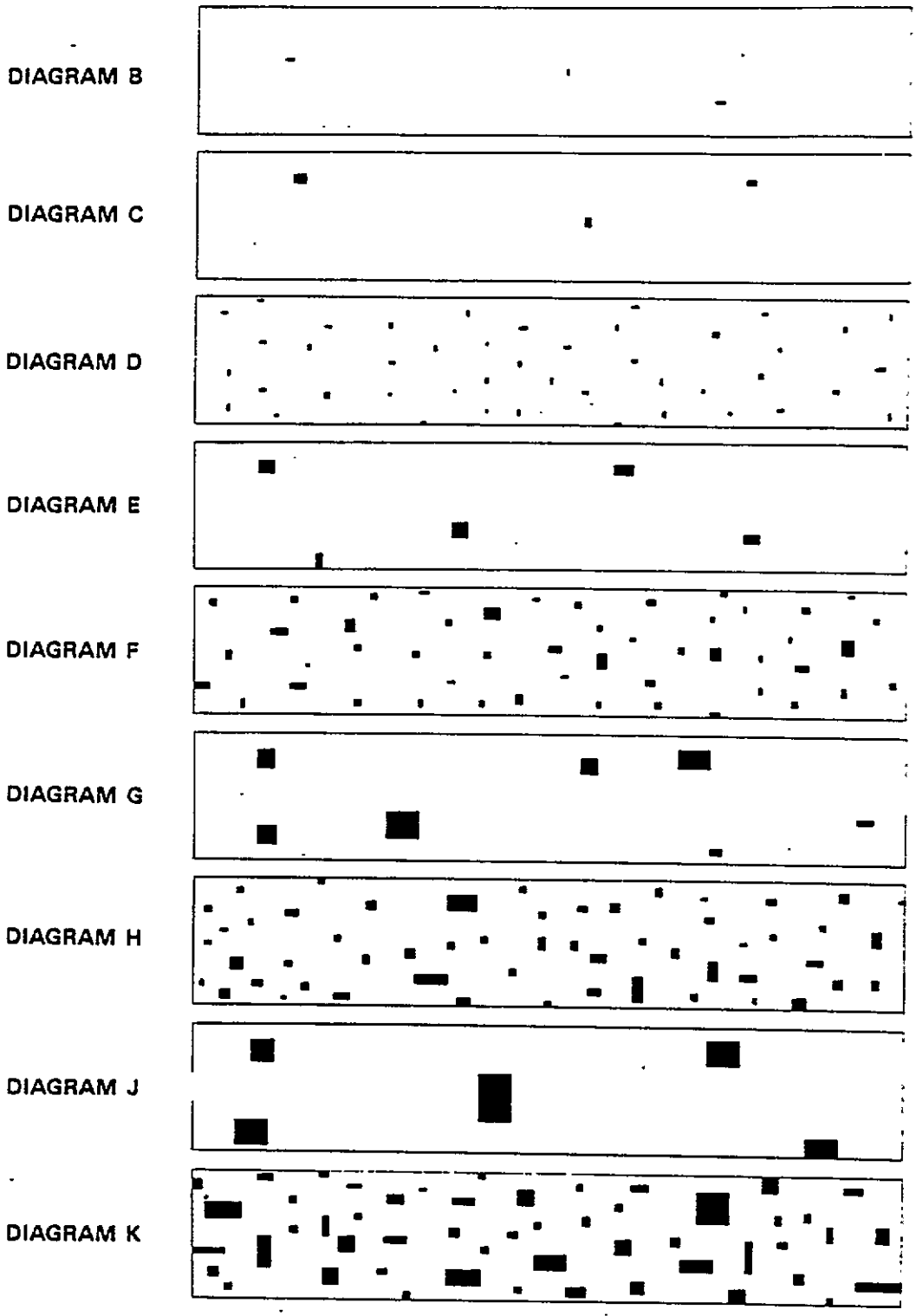


Fig. 5. Extent within affected area diagrams.

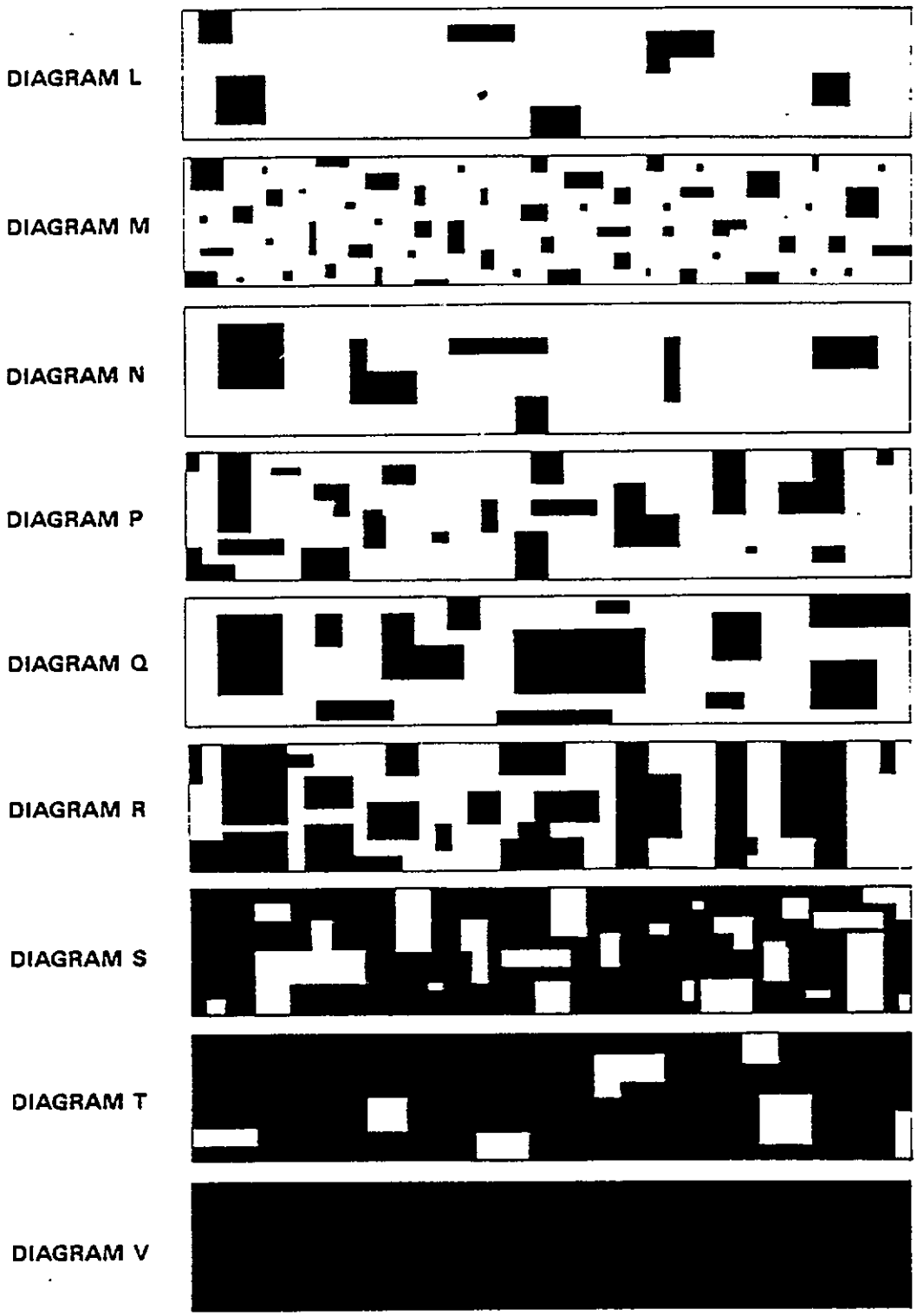
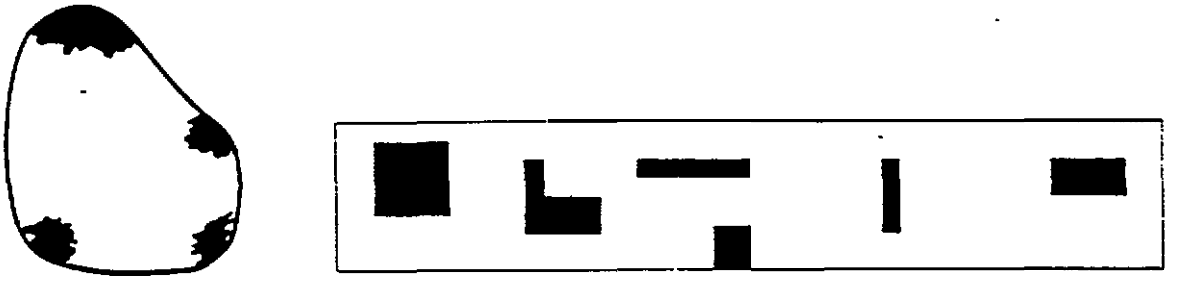


Fig. 5. (Continued)



Enclosed Area Diagram N

Fig. 6. Using the Extent Within Affected Area Diagrams (from Fig. 5) to select a matching pattern of corrosion.

For the corrosion example just completed, the inspector would record diagram designations 6 and N in appropriate locations on a standard reporting form. The blackened areas in both the Overall Extent Diagrams and the Extent Within Affected Area Diagrams are known percentages of the total area in the diagram. The percentage of the total inspection area which shows corrosion, for example, is simply the product of the selected Overall Extent Diagram percentage and the selected Extent Within Affected Area Diagram percentage. In our example, Diagram 6 is 25% and Diagram N is 15"%. Therefore, the total area affected by corrosion is .25 x .15, or 3.75% of the total inspection area.

The Extent Within Affected Area Diagrams (developed by International Paint Company) also show whether the coating damage is scattered across the entire area or localized in only a few spots . Information concerning the distribution of coating damage may be important.when planning maintenance work. Diagrams F and G in Fig. 7 below both show the extent of coating damage (represented by the black areas) as 3% of the total area.

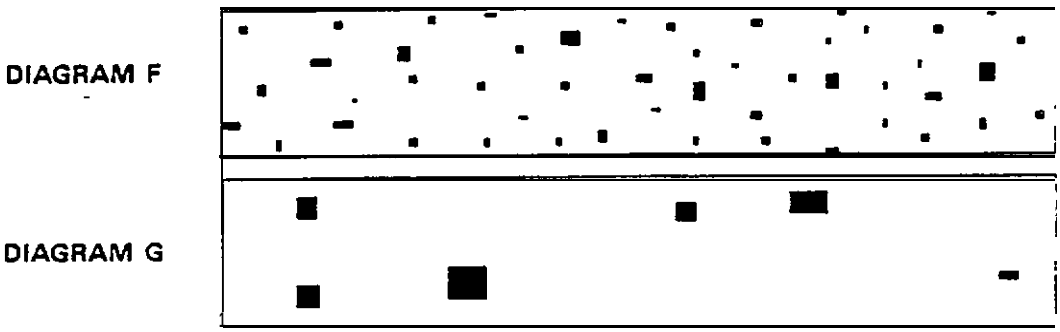


Fig. 7. Taking distribution as wall as extent of mating damage into account. Both diagrams show 3% of total area damagad, but damage is in a few localized adreas in Diagram G and spread evenly over the entire area in Diagram F.

Coating damage which occurs in only a few localized areas as represented in Diagram G could probably be repaired by spot-blasting or power-tool cleaning followed by touch-up painting. However, if the coating damage is distributed over the entire area as represented by Diagram F, the entire tank will probably require blasting and repainting.

The report form for inspection of tanks and voids is shown in Fig. 8. This form is simply a checklist of items which the inspector must consider. The valid responses that an inspector can enter on the report form have been designed to enhance reproducibility and to minimize human biases and judgmental errors. The various types of coating damage (corrosion, blistering, etc.) that must be considered are all reported using the Overall Extent and Extent Within Affected Area diagrams shown in Figs. 4. and 5, as previously discussed. Other inspection criteria which are listed on the report form are fully

AREA NO _____ DATE _____

SHIP NAME _____

HULL NUMBER _____

INSPECTOR'S NAME _____

REQUIRED PHOTOGRAPHS
1, ENTIRE AREA
2, CLOSE.UP OF AL DAMAGE

INSPECTION AREA OBSCURED Y ' N

1. CORROSION
A, GENERAL
I , O V E R A L L _ T
A, EXTENT WITHIN AFFECTED AREA

B MECHANICAL DAMAGE
I.OVERALL EXTENT . . . . . .
A. EXTENT WITHIN AFFECTED AREA E I
2. TYPE OF DAMAGE
A. SCRAPING.IMPACT. . . . . .
B INTERNAL WELDS/BURN MARKS

C. PITTING CORROSION
I. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA H

D, PIN-POINT CORROSION
1. OVERALL EXTENT. . . . . .
A, EXTENT WITHIN AFFECTED AREA

E. CORROSION ALONG WELDS? Y N

F . S T A I N I N G . Y N

II. PAINT CONDITION
A, DELAMINATION
1 . O V E R A L L
A. EXTENT WITHIN AFFECTED AREA . . .
2,TOPCOAT . . . . . .
3WITHIN REPAIR SYSTEM..,,. . . . . ':.;:"
4. BETWEEN ORIGINAL REPAIR .,
S. WITHIN ORIGINAL SYSTEM . . . . . .,,
6 TO SHOP PAIMER. . . . . .
7. TO STEEL SUBSTRATE 1
8. ORGANIC ODOR FROM DELAM. AREA? Y N
9 SAMPLE TAKEN. Y N

B. BLISTERING
1, OVERALL EXTENT
A, EXTENT WITHIN AFFECTEDAREA
2, SIZE(ASTM D714] . . . . . .
3 DENSITY' (ASTM 0714) . . . . . .
4.% BROKENBUSTERS ..:..... H
5. ORGANIC ODOR IN BUSTERS?, ... Y N
6.BLISTERS CONTAIN WATER? V N
A.pH .,
7. CORROSION UNDER BLISTERS? Y N

C. CRAKING
1. OVERALL EXTENT . . . . . .
A. EXTENT WITHIN AFFECTED AREA . .. D... D

D. CHECKING
I.OVERALL EXTENT . . . .
A. EXTENT WITHIN AFFECTED AREA.

E FLAKING
7 . O V E R A L L E X T E N T
A. EXTENT WITH AFFECTED AREA
2. SEVERITY . . . . . .

F. SAGS OR CURTAINS? . . . . . Y N

G. CHALKING? . . . . . Y N

H. D1SCOLORATION? Y N

I SOFTENING?, . Y N

J VALVES, PIPING. HEATING COILS PRESENT Y N
1. COATING DAMAGE IN ADJACENT AREAS? Y N

K. STIFFENEAS PRESENT?. ., Y N
1. COATING DAMAGE BEHIND STIFFENERS? Y N

L. ANODES PRESENT? ,. Y N
1. COATING DAMAGE IN ADJACENT AREAS? . Y N
2. ANODES FUNCTIONING? . . . . Y N

M. KNIFE TEST
1. ACCEPTABLE.. . Y N
IF ,W. MARK LEVEL(S) BELOW
A. TOPCOAT ,.
& WITHIN REPAIR SYSTEM ~
C BETWEEN ORIGINAL/REPAIR
D. WITHIN ORIGINAL SYSTEM
E. T0 SHOP PRIMEIR
F. TO STEEL SUBSTRATE . . . . . .

111. MEASURED PROPERTIES
A. DRY FILM THICKNESS
1. MORE DFT READINGS? . . . . . Y N

Fig. 8. Report form for inspection of tanks and voids

described in the standard inspection procedure manuals. Four standard inspection procedures with the following designations have been approved by the American Society of Testing and Materials (ASTM) as ASTM standards:

(1) ASTM F-1130-88
TEST METHOD FOR INSPECTING THE COATING SYSTEM OF A SHIP'S UNDERWATER HULL AND BOOTTOP DURING DRYDOCKING
(ASTM Designation F2502-O1O1 for draft in Appendix A)

(2) ASTM F-1131-88
TEST METHOD FOR INSPECTING THE COATING SYSTEM OF A SHIP'S TANKS AND VOIDS
(ASTM Designation F2502-0102 for draft in Appendix A)

(3) ASTM F-1132-88
TEST METHOD FOR INSPECTING THE COATING SYSTEM OF A SHIP'S DECKS AND DECK MACHINERY
(ASTM Designation F2502-0103 for draft in Appendix A)

(4) ASTM F-1133-88
TEST METHOD FOR INSPECTING THE COATING SYSTEM OF A SHIP'S TOPSIDE AND SUPERSTRUCTURE
(ASTM Designation F2502-0104 fOr draft in Appendix A)

Draft copies of all four inspection procedures are included in their entirety in Appendix A. The standards have not yet been published by ASTM.

All four procedures are intended for use only by experienced marine coating inspectors. Some of the skills an inspector must have are the ability to recognize various fouling organisms, the ability to recognize different types of paint failure (blistering, corrosion, etc.), familiarity with different ship areas, and the ability to calibrate and use a magnetic dry film thickness guage. The inspection procedures were designed to standardize inspection and reporting methods; they are not intended to be comprehensive training manuals.

SHIP TESTING OF THE STANDARD PROCEDURE FOR INSPECTING TANKS AND VOIDS

About three years ago, the Navy began to inspect submarine main ballast tanks using the standard procedure and report form for inspecting tanks and voids. After inspecting several main ballast tanks, the Navy modified the standard inspection report form to meet its own requirements.

The primary purpose of the Navy inspection is to evaluate corrosion and blistering of the paint in the tank so that a decision can be made about the tank's maintenance painting requirements. Therefore, only those criteria that are used to determine maintenance requirements, such as extent of corrosion or blistering, are important. Criteria that show how or why a coating failed, such as measuring the pH of the liquid in blisters, are not used to determine maintenance requirements and were deleted from the report form. Other criteria. on the standard form, such as chalking, discoloration, or softening, were never observed in submarine ballast tanks and were also deleted.

Also, submarine ballast tanks contain some inspection areas not found in a typical ship tank, such as air flasks, which were not included on the standard inspection form. Therefore the Navy added new criteria to its modified form. The revised Navy form is shown in Fig. 9.

In addition to the deletion of several inspection criteria and the insertion of criteria specific to submarines, two major changes were made to the inspection procedure. First, because they are significantly smaller than most tanks on commercial

ASSESSMENT OF SUBMARINE TANKS/VOIDS

AREA NO. _____ DATE _____

SHIP NAME, NUMBER _____

INSPECTOR'S NAME AND CODE (PRINTED) _____

I. NON-SEPTUM PLATED AREA
- A. CORROSION
  - 1. % GENERAL CORROSION
  - LOCALIZED SCATTERED
  - 2. % PITTING CORROSION
  - A. MAXIMUM DEPTH (INCHES)
  - 3. ANODES PRESENT? Y N
  - A. % DEPLETION
    - UPPER 1/3
    - MIDDLE 1/3
    - BOTTOM 1/3
    - BELOW WL
  - 4. NO. OF LEAD BINS WITH RUST BLEED
- B. PAINT CONDITION
  - 1. BLISTERING
    - A. % EXTENT
    - B. DENSITY (ASTM D714)
    - C. SIZE (ASTM D714)
  - 2. VALVES/PIPING
    - A. PIPING COATED? Y N
    - B. % COATING MISSING

II. NON-SEPTUM PLATED AREAS AND AIR FLASKS
- A. DELAMINATION Y N
  - 1. % EXTENT
  - 2. PRIMER/STEEL. Y N
  - 3. LAYERS OF PAINT Y N
- B. TOUCHUPS PRESENT? Y N
  - 1. % EXTENT
  - 2. % TOUCHUPS FAILED
- C. DRY FILM THICKNESS (MILS)

III. AIR FLASKS

A. CORROSION	EASY TO PAINT AREAS	HARD TO PAINT AREAS
1, % GENERAL CORROSION		
2 % PITTING CORROSION		
a. MAX DEPTH (INCHES)		

- B. PAINT CONDITION
  - 1. BUSTERING
    - a % EXTENT
    - b. DENSITY [ASTM Dn4)
    - c. SIZE (ASTM Dn4]

IV. SEPTUM PLATED. AREA
- A. % OF TANK COVERED
- B. % PLATES STEEL
- C. % CORROSION ON STEEL
- D. % DAMPING TILES WITH RUST BLEED COMING FROM UNDER THEM

V. LINE ARRAY
- 1. DOES LINE ARRAY HAVE CORROSION SIGNIFICANTLY GREATER THAN TANK AS A WHOLE OR PITTING CORROSION Y N
- 2. IF YES EVALUATE ARRAY SEPARATELY

VI. ADDITIONAL COMMENTS:

Fig. 9. **Revised inspection report form for Navy use in inspecting tanks and voids.**

ships, submarine tanks did not need to be divided into the individual inspection areas (top, bottom, inboard, outboard, forward, and aft) for inspection of each area individually. The coating damage was usually distributed evenly throughout the tanks and the tanks were not so large.that division into smaller parts was necessary. Therefore the inspection of the entire tank was reported on one form. Also, the use of both the Overall Extent Diagrams and the Extent Within Affected Area Diagrams was not necessary for submarine ballast tank inspection. The two sets of diagrams had been developed for use while inspecting a ship's hull, which has a much larger area than a tank. Because the inspection areas were so much smaller, only the Extent Within Affected Area Diagrams (produced by International Paint Company) were used. In the Navy manual, these diagrams will be called simply Extent Diagrams.

CONCLUSIONS

The purpose of these inspection standards is to provide inspection criteria and methods for measuring these criteria that produce accurate, reproducible results so that one can examine a completed report form and accurately **assess** coating damage as well as have some idea as to how and why the damage occurred.

However, these inspection standards are intended to be guidelines, not rigid methods that cannot be modified. Ship inspections are conducted by many organizations for different purposes and these inspection standards are designed so that inspection criteria can be added or deleted in order to meet different objectives. The Navy's experiences illustrate this

point.

Although refinements and modifications will be required as the inspection standards are practiced, these standards provide criteria and methods that produce accurate and reproducible results.

REFERENCES

1. International Data Plan Inspectors Manual, International Paint Co: (No date)

APPENDIX A

ASTM Designation F2502-O101

STANDARD METHOD FOR INSPECTING THE COATING SYSTEM OF A SHIP ' S UNDERWATER HULL AND BOOTTOP DURING DRYDOCKING

1. SCOPE

1.1 This method describes a standard procedure for inspecting the coating system of ship's underwater hull and bottop area during drydocking. Included are a standard inspection form to be used for reporting the inspection data, a diagram which divides the entire underwater hull and boottop of the ship into smaller, individual inspection areas, and a series of diagrams which are used co report the extent of damage to the coating system on the hull. This method is intended for use only by an experienced marine coating inspector.

2. APPLICABLE DOCUMENTS

2.1 ASTM Standards

- o D714 Standard Method of Evaluating Degree of Blistering of Paints
- o D772 Standard Method of Evaluating Degree of Flaking (Scaling) of Exterior Paints

2.2 Steel Structures Painting Council (SSPC)

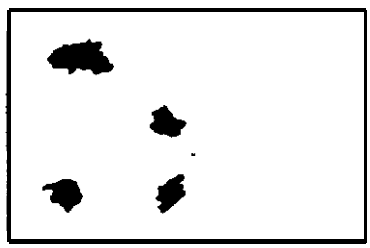
- o SSPC-PA-2 Measurement of Dry Paint Thickness with Magnetic Gages

2.3 The British Ship Research Association

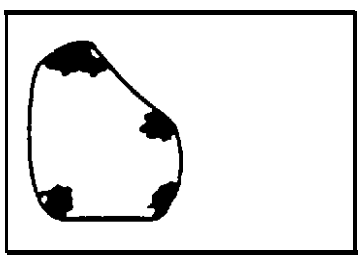
- o Hull Roughness Analyzer

3. REFERENCE STANDARDS

3.1 OVERALL EXTENT DIAGRAMS (Figure 1), EXTENT WITHIN AFFECTED AREA DIAGRAMS (Figures 2, and 3). The 'OVERALL EXTENT DIAGRAMS' and 'EXTENT WITHIN AFFECTED AREA DIAGRAMS' are used to report the area covered by various fouling organisms, different types of corrosion , and paint failures. The ' oVERALL EXTENT DIAGRAMS' are used first to group all areas where a particular type of damage has occurred into one contiguous block. The ' EXTENT WITHIN AFFECTED AREA DIAGRAMS ' are then used to identify the pattern of damage within that contiguous block. For example, suppose you are inspecting for 11.A (Corrosion General (see Figure 8)) and general corrosion appears distributed over the entire inspection area as shown by the black areas in the diagrams 'below.



The first step is to draw an imaginary line which would enclose all of the general corrosion. This enclosure should be as small as possible. Now select the diagram from the OVERALL EXTENT DIAGRAMS which most closely approximates the enclosed area with respect to the entire inspection area. Using the general corrosion example, the enclosed area (shaded area) would closely match Diagram 6.



Enclosed Area

Diagram 6

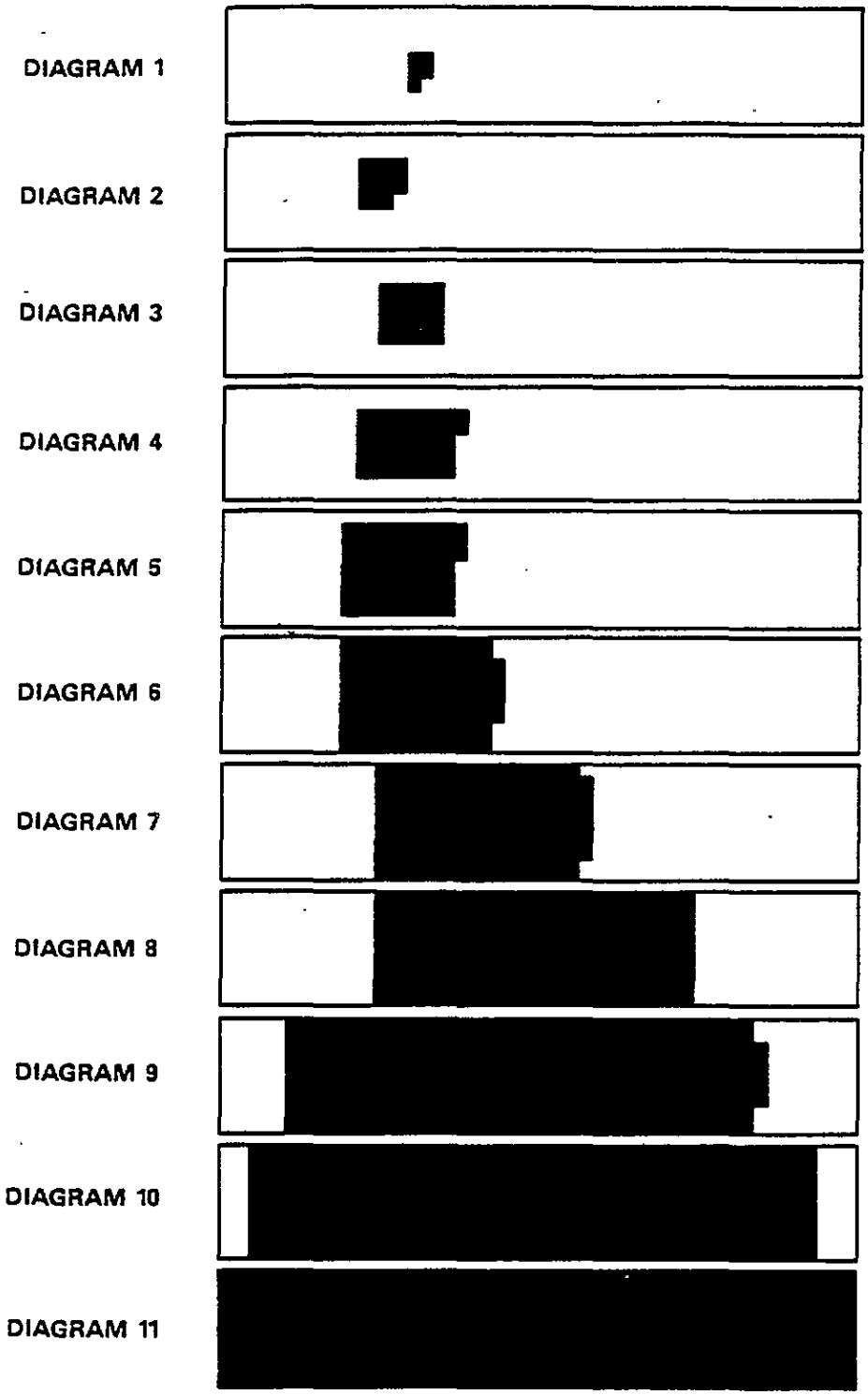


Fig. 1. Overall extent diagrams.

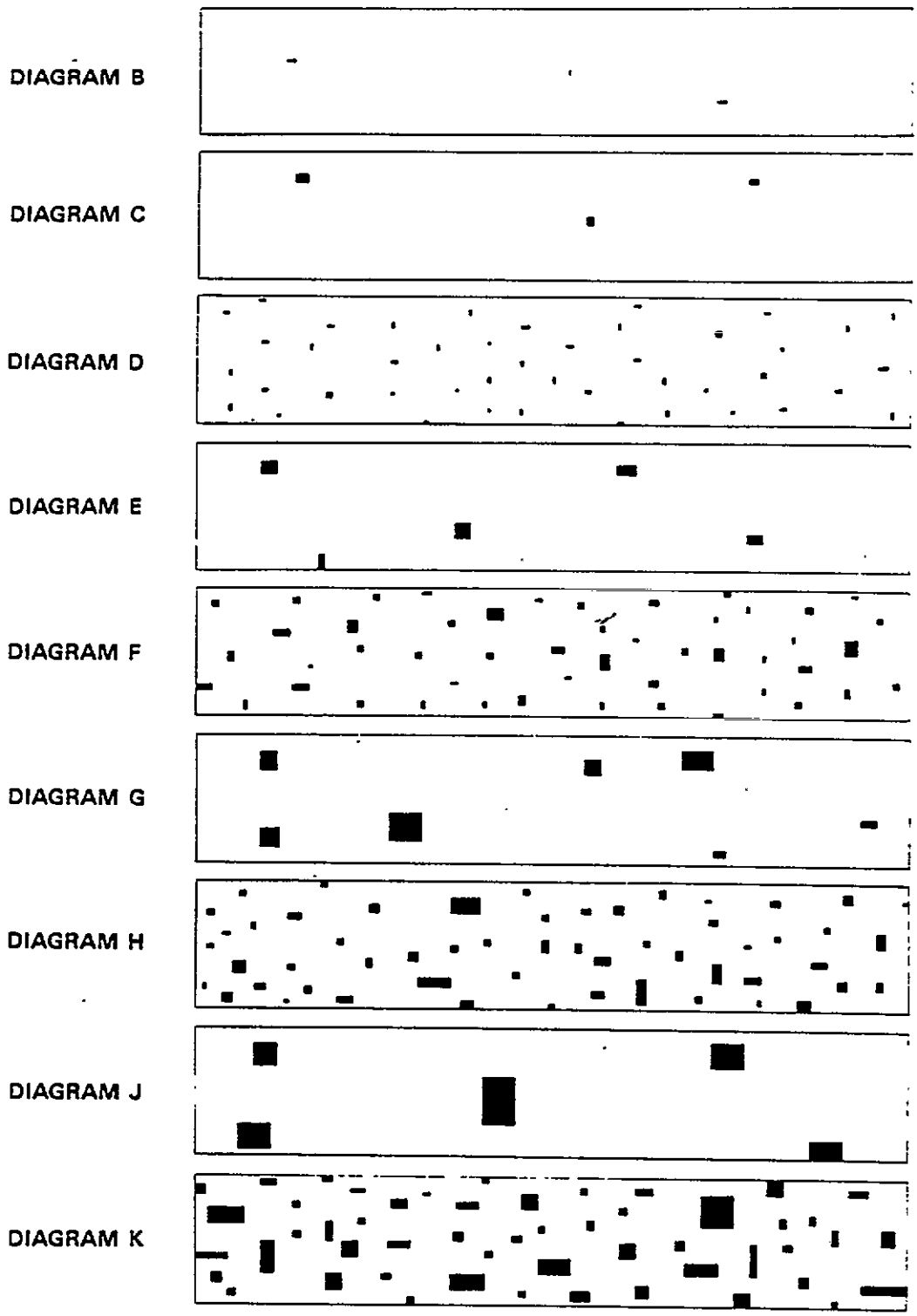


Fig. 2. Extent within affected area diagrams.

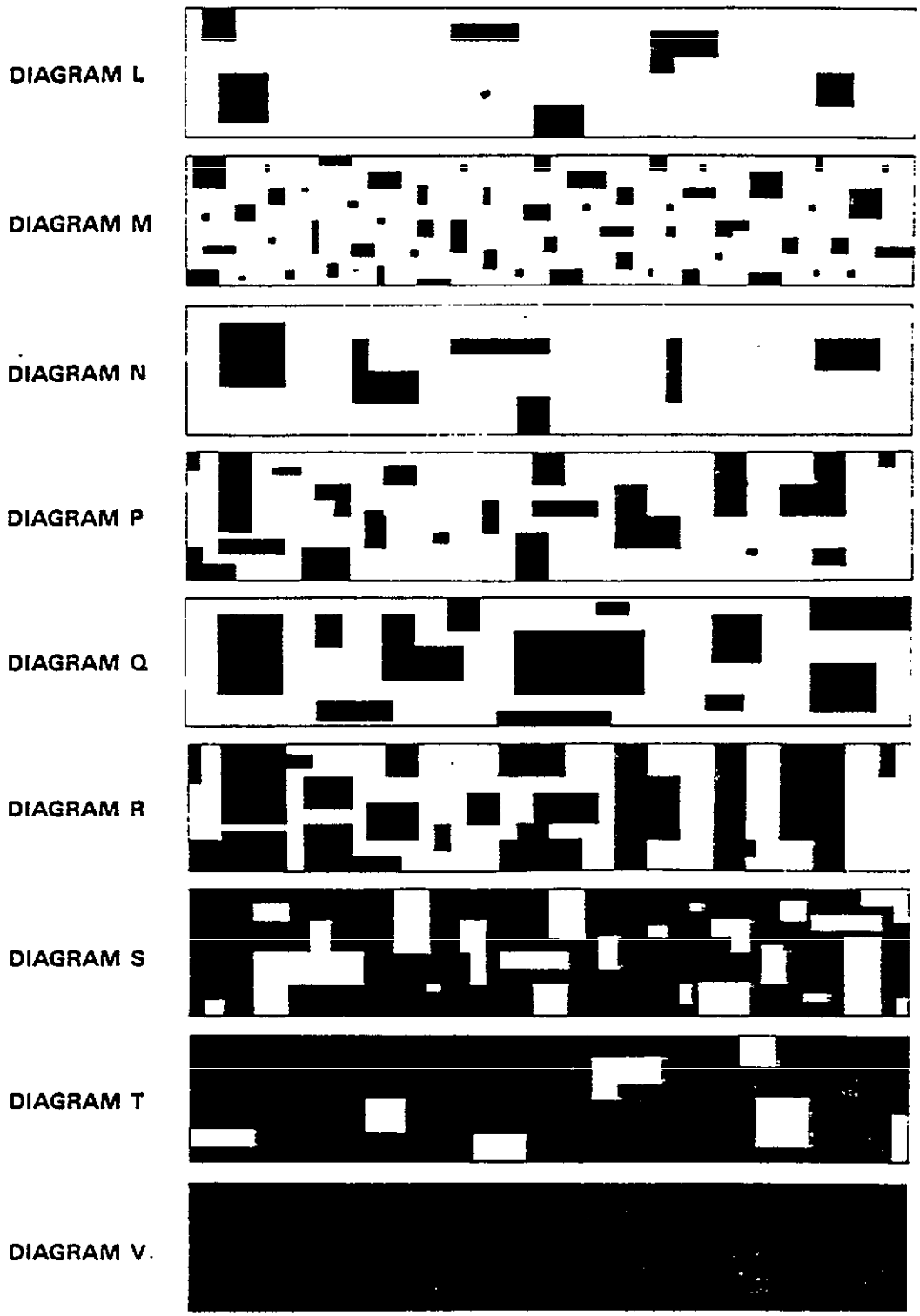
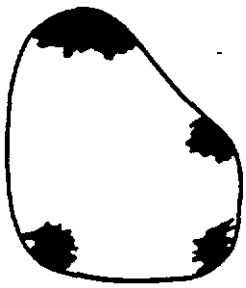


DIAGRAM L
DIAGRAM M
DIAGRAM N
DIAGRAM P
DIAGRAM Q
DIAGRAM R
DIAGRAM S
DIAGRAM T
DIAGRAM V

Fig. 3.

Enter a ‘6’ (for diagram 6) in the box next to 11.A.1. OVERALL EXTENT in Figure 8.

The second step is to look at only the enclosed area and select the diagram from the EXTENT WITHIN AFFECTED AREA DIAGRAMS which most closely identifies the pattern of general corrosion in the enclosed area. In this example, diagram N would be a good choice.



Enclosed Area

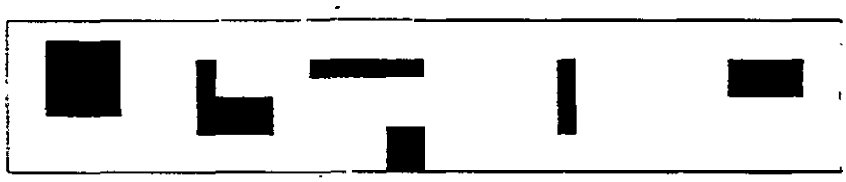


Diagram N

Enter an ‘N’ (for diagram N) in the box next to 11 .A. 1.A. EXTENT WITHIN AFFECTED AREA.

NOTE : Selection of diagrams is based on visual comparisons and therefore different inspectors may select different diagrams. However, the diagrams are designed co minimize these differences and enhance reproducibility.

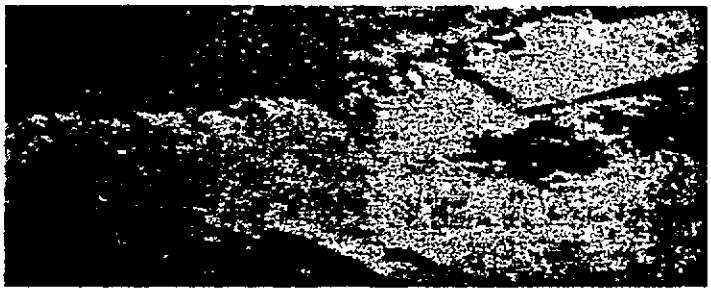
3.2 FORMS OF MECHANICAL DAMAGE

This reference standard (Figure 4) is a series of photographs used to identify the various forms of mechanical damage to a coating which can lead to corrosion.

3.3 TYPES OF CORROSION

This reference standard (Figure 5) is a series of photographs used to show examples of general corrosion, pitting corrosion , pin-point corrosion, and cavitation corrosion.

GROUNDING



SCRAPING/
IMPACT

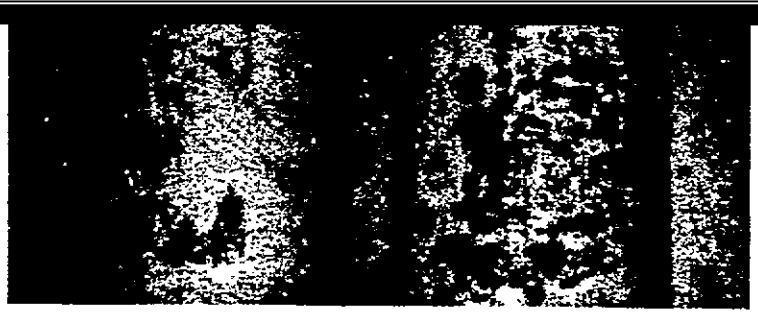
ANCHOR CHAINS/
ROPES

INTERNAL WELDS/
BURNS

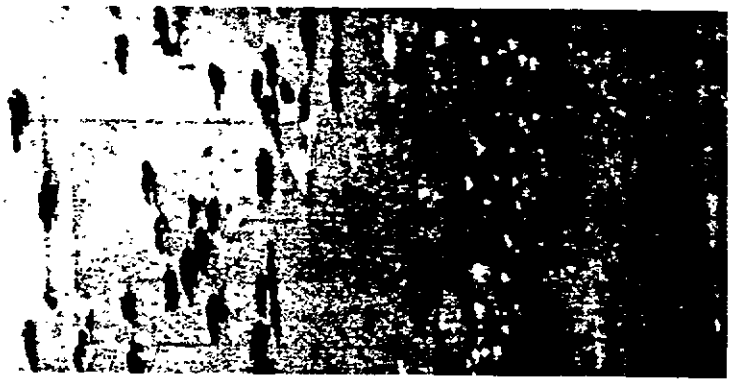
DAMAGE FROM
SCRUBBING

Fig. 4. Forms of mechanical damage.

GENERAL
CORROSION



PITTING
CORROSION



PIN-POINT
CORROSION

CAVITATION
CORROSION

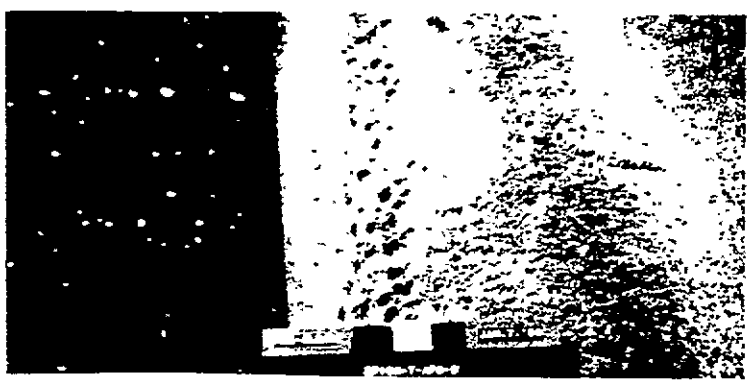


Fig. 5. Types of corrosion.

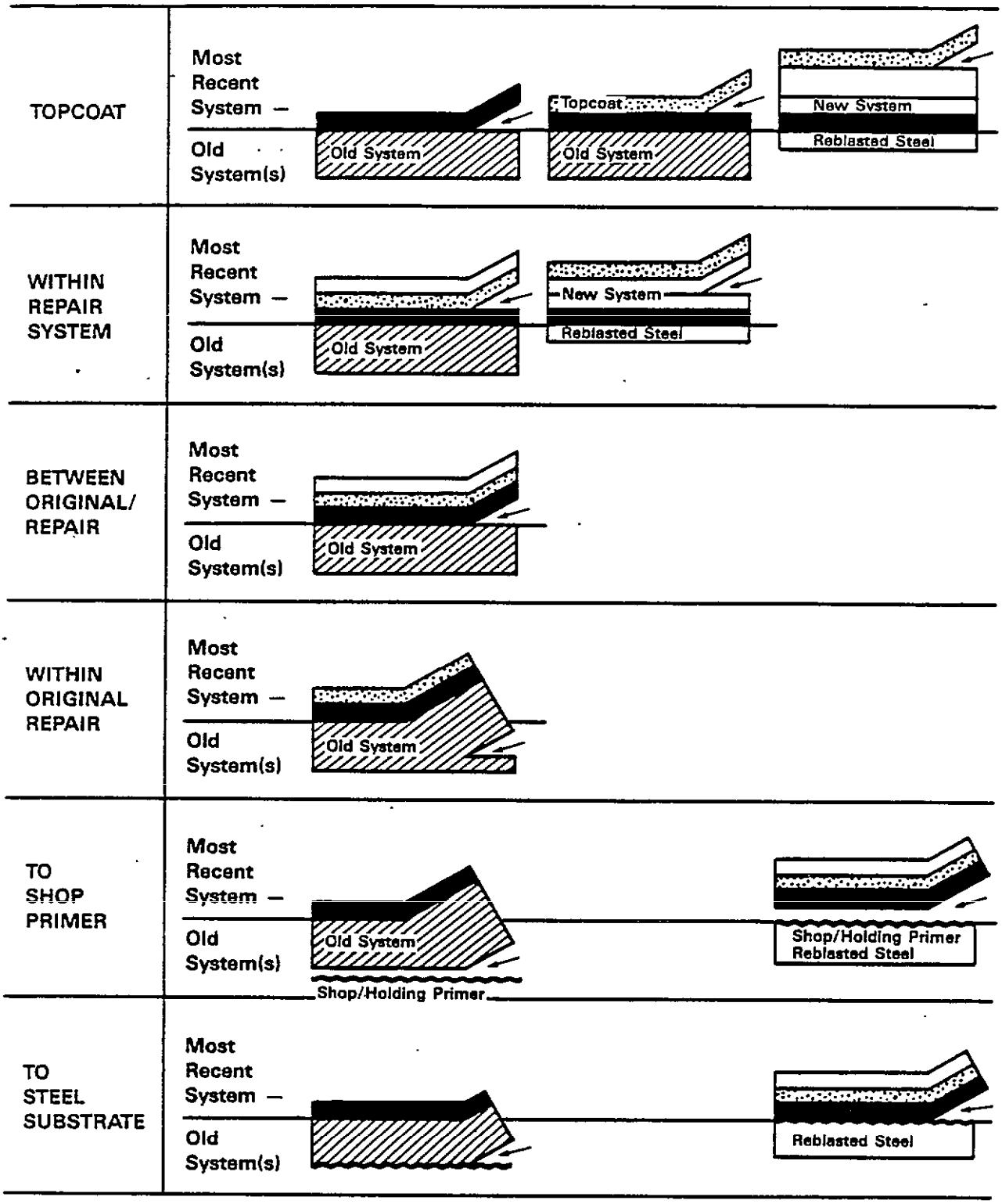


Fig. 6. Levels of delamination.

3.4 LEVELS OF DELAMINATION

This reference standard (Figure 6) is a series of diagrams which identifies the levels in a coating system where delamination can occur.

4. REQUIREMENTS

The inspector muse know how co perform the following tests:

4.L Calibrate and use a magnetic guage to measure dry film thickness.

4.2 Calibrate and use a hull roughness analyzer (Instrument available from the British Ship Research Association) to measure the surface roughness of the hull

4.3 Use pH paper properly.

4.4 Use a camera properly.

4.5 Recognize the various types of fouling organisms, corrosion, and forms of paint failures (blistering, delamination, etc.).

4.6 Recognize the various ship areas as described in figure 9.

5. PROCEDURE AND REPORTING

The inspection form consists of two pages co be completed by the inspector and four pages of reference standards. The first of the two pages co be completed by the inspector is shown in Figure 7. This form, which is self - explanatory, requests general information about the ship.

The second page of the inspection form to be completed by the inspector is shown in Figure 8. The underwater hull and boottop are divided into eleven inspected areas. These eleven inspection areas are defined by the diagram in Figure 9. For each of the inspection areas delineated in Figure 9, the

STANDARDIZED INSPECTION - BOOTTOP ND UNDERWATER HULL

NAME OF VESSEL AND HULL NUMBER _____

B. **DRYDOCK LOCATION (SHIPYARD)** _____

c. **DATE OF DRYDOCKING** _____

D. **DATE AND LOCATION OF LAST DRYDOCKING OR** DATE AND LOCATION OF DELIVERY YARD _____

E. IDENTIFICATION OF LAST COATING SYSTEM APPLIED (MANUFACTURER AND I.D.)

_____

F. **HULL** HIGH PRESSURE WATER WASHED? _____

G. ADDITIONAL COMMENTS:

_____

_____

_____

_____

_____

_____

_____

H. INSPECTOR'S SIGNATURE _____

I. INSPECTOR'S NAME (PRINT) _____

J. _____

Fig. 7.

inspector is co complete a separate inspection form (shown in Figure 8). Therefore, for a complete underwater hull inspection, the inspector must complete eleven of the forms shown in Figure 8. Detailed instructions for completing the form shown in Figure 8 are given below.

AREA No. - The underwater hull and boottop are segmented into eleven distinct inspection areas. Enter the code for the area being inspected. For example, enter 'P1 ' for the part bow inspection , 'S1' for the port starboard, etc. A complete list of hull segments and their codes is shown in Figure 9.

DATE - Enter the date of the inspection. If the inspection requires more than one day, enter the date the inspection is completed.

SHIP NAME - Enter the ship's name (Eg. USS TRENTON).

HULL NUMBER - Enter the hull number of the ship (Eg. LPD 14).

INSPECTOR'S NAME - The Inspector should print his name.

REQUIRED PHOTOGRAPHS - For each inspection area, a photograph of the entire area is required. If the 5 - is too large to capture in one photograph, the area should be divided into equal sized segments and each segment should be photograph. An individual close-up photograph of each damaged section in the inspection 5 - is required. Each photograph should be marked with the Area No., Ship Name, and Date. Also, a 'size scale' should be captured in each photograph. This 'size scale' is a reference standard which would be used to determine the approximate size of the photographed ship area. For example, a 12 inch rule might be an appropriate Size Scale fOr a relatively small ship area.

AREA NO. ______________ DATE ______________

SHIP NAME ______________________________

HULL NUMBER ______________________________

INSPECTOR'S NAME ______________________________

REQUIRED PHOTOGRAPHS
1. ENTIRE AREA
2. CLOSE-UP OF ALL DAMAGE

I. FOULING
- A. SLIME
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- B. GRASS
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- C. BARNACLES
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- D. TUBEWORMS
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- E. OTHER
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- F. CORROSION/PAINT FAILURES OBSCURED BY FOULING? Y N
- G. PITTING UNDER FOULING? Y N

II. CORROSION
- A. GENERAL
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- B. MECHANICAL DAMAGE
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
  - 2. TYPE OF DAMAGE
    - A. GROUNDING ☐
    - B. SCRAPING/IMPACT ☐
    - C. ANCHOR CHAINS/ROPES ☐
    - D. INTERNAL WELDS/BURNING ☐
    - E. DAMAGE FROM SCRUBBING ☐
- C. PITTING CORROSION
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- D. PIN-POINT CORROSION
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- E. CAVITATION (P5, S5, A ONLY)? Y N

III. PAINT CONDITION
- A. DELAMINATION
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
  - 2. TOPCOAT ☐
  - 3. WITHIN REPAIR SYSTEM ☐
  - 4. BETWEEN ORIGINAL/REPAIR ☐
  - 5. WITHIN ORIGINAL SYSTEM ☐
  - 6. TO SHOP PRIMER ☐
  - 7. TO STEEL SUBSTRATE ☐
- B. BLISTERING
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
  - 2. SIZE (ASTM D714) ☐
  - 3. DENSITY (ASTM D714) ☐
  - 4. % BROKEN BLISTERS ☐
  - 5. ORGANIC ODOR IN BLISTERS? Y N
  - 6. BLISTERS CONTAIN WATER? Y N
    - A. pH ☐
  - 7. CORROSION UNDER BLISTERS Y N
- C. CRACKING
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- D. CHECKING
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
- E. FLAKING
  - 1. OVERALL EXTENT ☐
    - A. EXTENT WITHIN AFFECTED AREA ☐
  - 2. SEVERITY ☐
- F. SAGS OR CURTAINS? Y N
- G. EROSION? Y N
- H. KNIFE TEST
  - 1. ACCEPTABLE? Y N
    - IF 'N', MARK LEVEL(S) BELOW
    - A. TOPCOAT ☐
    - B. WITHIN REPAIR SYSTEM ☐
    - C. BETWEEN ORIGINAL/REPAIR ☐
    - D. WITHIN ORIGINAL SYSTEM ☐
    - E. TO SHOP PRIMER ☐
    - F. TO STEEL SUBSTRATE ☐

IV. MEASURED PROPERTIES
- A. DRY FILM THICKNESS (MILS)

_:_:_ _:_:_ _:_:_ _:_:_ _ _ _
_:_:_ _:_:_ _:_:_ _:_:_ _ _ _
_:_:_ _:_:_ _:_:_ _:_:_ _ _ _
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_:_:_ _:_:_ _:_:_ _:_:_ _ _ _
_:_:_ _:_:_ _:_:_ _:_:_ _ _ _
_:_:_ _:_:_ _:_:_ _:_:_ _ _ _

  - 1. MORE DFT READINGS? Y N
- B. SURFACE ROUGHNESS READINGS TAKEN? Y N

V. DIELECTRIC SHIELDS

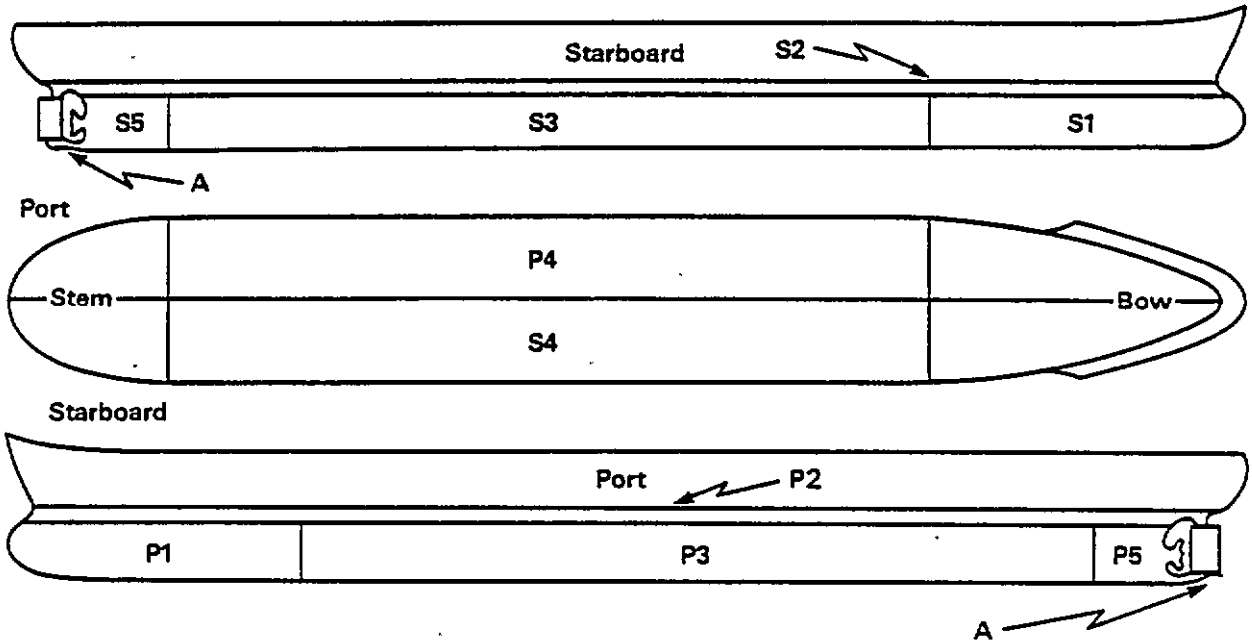
	PRIM.	SEC.
A. BLISTERING?	Y N	Y N
B. DELAMINATION?	Y N	Y N
C. FOULING?	Y N	Y N
D. CORROSION		
1. GENERAL?	Y N	Y N
2. PITTING?	Y N	Y N
E. FILM THICKNESS (MILS)	☐	☐
F. CALCAREOUS DEPOSIT?	Y N	Y N
G. EROSION?	Y N	Y N

Fig. 8.

STANDARDIZED INSPECTION
BOOTTOP AND UNDERWATER HULL

I. Limitation:

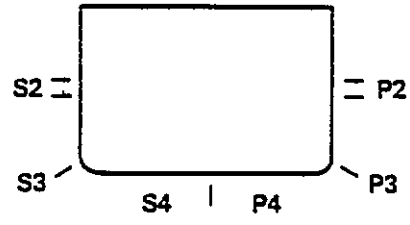
This inspection reporting form is designed and limited for use in inspecting the boottop and underwater hull of the ship as soon as it is accessible upon docking.



II. Inspection Areas:

The hull is seqmented into eleven distinct inspection areas as follows:

P1 – Port Bow
P2 – Port Boottop
P3 – Port Side
P4 – Port Flat
P5 – Port Stern
S1 – Starboard Bow
S2 – Starboard Boottop
S3 – Starboard Side
S4 – Starboard Flat
S5 – Starboard Stern
A – Appendages – Struts, Rudder, etc.



Each area is to be inspected for all the properties listed in the accompanying table.

Fig. 9. Standardized inspection, boottop and underwater hull.

I. FOULING

A. SLIME

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. 1), enter the number of the diagram which most closely approximates the overall extent of slime fouling. If there is no slime fouling in this inspection area, enter the number 'O' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED .AREA DIAGRAMS (diagrams and instrucions for use in section 3. 1) , enter the letter of the diagram which most closely approximates the extent of slime fouling" within the affected area. Remember, if the OVERALL EXTENT box above uis ❑ marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

B. GRASS

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. 1), enter the number of the diagram which most closely approximates the overall extent of grass fouling. If there is no grass fouling in this inspection area, enter the number 'O' (zero)", and Leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3. 1), enter the letter of the diagram which most closely approximates the extent of grass fouling within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O ' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

C. BARNACLES

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and

3Instructions for use in Section 3. 1), enter the number of the diagram which most closely approximates the overall extent of barnacle fouling. If there is no barnacle fouling in this inspection area, enter the number ‘O’ (zero), and leave the next box (EXTENT WITHIN” AFFECTED AREA) blank.

a . EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of barnacle fouling within the affected area. Remember, if the OVERALL EXTENT box above is marked with a ‘O’ (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

D. TUBEWORMS

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of tubeworm fouling. If there is no tubeworm fouling in this inspection area, enter the number ‘O’ (zero), and leave .the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of tubeworm fouling within the affected area. Remember, if the OVERALL EXTENT box above is marked with a ‘ O‘ (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

E. OTHER

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of fouling ocher than slime, grass barnacle, or tubeworm fouling. If there is no fouling other than slime, grass barnacles, or tubeworms in this inspection area, enter the number ‘O’ (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of fouling other than slime, grass, barnacles, or tubeworms within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero) , leave the EXTENT WITHIN AFFECTED AREA box blank.

NOTE : Combinations of Fouling on the Same Area

In order co properly evaluate antifouling performance, the total fouling in any inspection area must not exceed 100%.

From a technical standpoint, barnacle, tubeworm, and grass fouling are more significant than slime fouling. Therefore, any slime fouling present on cop of or underneath barnacles, tubeworms, or grass should not be reported so that the combined fouling percentage is not greater than 100%. However, slime fouling alone is present elsewhere in the inspection area, this slime fouling should be reported.

F. CORROSION/PAINT FAILURES OBSCURED BY FOULING?

G. PITTING UNDER FOULING?

In each fouled area the inspector should remove the fouling (by brushing or scraping) in a 4 inch x 4 inch patch down to the painted surface. If corrosion or paint failures (i.e. blistering, cracking, etc.) are present beneath the fouling, circle the 'Y' after F. CORROSION/PAINT FAILURES OBSCURED BY FOOLING?

If no corrosion **or** paint failures are present, circle the 'N'.

If the metal substrate has indentations **or** pits, circle the 'Y' after G. PITTING UNDER FOULING? If the metal substrate is relatively smooth and free of indentations and pits, circle the 'N'.

II. CORROSION

The inspector should distinguish between four types of corrosion and report each type separately. The four types of corrosion are:

1. GENERAL CORROSION - General corrosion, for the purposes of this inspection form, is all corrosion which is not covered in the mechanical damage, pitting corrosion, or pin-point corrosion sections below. Patches of common, ordinary rusting are classified as general corrosion.

2. MECHANICAL DAMAGE - Mechanical damage corrosion is corrosion that occurred because the paint was removed from the hull by some type of scraping or impact against the hull. With the paint removed and the steel hull exposed to sea water, corrosion occurred. Photographic examples of corrosion due to various forms of mechanical damage (i.e. grounding, scraping /impact, anchor chains/ropes, internal welds/burning and scrubbing) are shown in section 3.2.

3. PITTING CORROSION - Pitting corrosion is a more advanced form of localized corrosion. Pitting corrosion is characterized by visible indentations or pits which have penetrated in to the steel hull surface. These pits distinguish between pitting corrosion and general corrosion , the latter being characterized by a layer of rust which does not penetrate locally into the surface but is more uniform in extent. A photographic example of pitting corrosion is shown in section 3.3.

4. PIN-POINT CORROSION - Pin-point corrosion is characterized by a pattern of small spots (pin-points) of rust. A photographic example of pin-point corrosion is shown in section 3.3.

A. GENERAL

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of general corrosion. If there is no general corrosion in this inspection area, enter the number 'O ' (zero) , and leave the next box .(EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1) , enter the letter of the diagram which most closely approximates the extent of general corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank. .

B. MECHANICAL DAMAGE

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of corrosion due to mechanical damage. If there is no corrosion due to mechanical damage in this inspection area, enter the number 'O' (zero) , and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT wITHIN AFFECTED AREA DIAGRAMS (diagrams and Instructions for use in section 3. 1), enter the letter of the diagram which most closely approximates the excent of corrosion due to mechanical damage within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. TYPE OF DAMAGE - If corrosion due to mechanical damage has occurred, use the photographic examples in section 3.2 to identify the type of mechanical

damage which has occurred. On the inspection form, mark an 'X' in the box next to the type of damage (i.e. grounding, scraping/impact, anchor chains/ ropes, internal welds/burning, damage from scrubbing) which has occurred.

C. PITTING CORROSION

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of pitting corrosion. If there is no pitting corrosion in this inspection area, enter the number 'O'. (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT wITHIN AFFECTED *AREA DIAGRAMS (diagrams and instructions for use in section 3. 1), enter the letter of the diagram which most closely approximates the extent of pitting corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

D. PIN-POINT CORROSION

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. 1), enter the number of the diagram which most closely approximates the overall extent of pin-point corrosion. If there is no pin-point corrosion in this inspection area, enter the number 'O' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of pin-point corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

E. CAVITATION (P5, s5, A ONLY) - If you are not inspecting the P5 (port stern), S5 '(starboard stern), or A (Appendages - Struts, Ruddler, etc.) inspection area, ignore this section. If You are inspecting the P5, S5 or A area, use the photographic example in Section 3.3 co determine if cavitation has occurred. If cavitation has occurred circle the 'Y' next to 'E. CAVITATION (P5, S5, A ONLY)!. If cavitation has not occurred, circle the 'N'.

III . PAINT CONDITION

A. DELAMINATION - Delamination is characterized by detachment of the coating from the substrate or by a layer separation between the coats of pain t.

1. OVERALL EXTENT - Using the OVERALL EXTENT. DIAGRAMS (diagrams and instructions for use in Section 3.1) , enter the number of the diagram which most closely approximates the overall extent of delamination. If there is no delamination in this inspection area, enter the number 'O ' (zero) , and move down to 'B. BLISTERING ' .

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of delamination within the affected area. Remember, if the OVERALL EXTENT box above fs marked with a ' O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. TOPCOAT - Mark an 'X' in the box beside 'TOPCOAT' if cop coat delamination has occurred. Top coat delamination has occurred if only the outermost coating has separated from all undercoats. A diagram of TOPCOAT delamination is shown in Section 3.4.

3. WITHIN REPAIR SYSTEM - Mark an 'X' in the box beside 'WITHIN REPAIR SYSTEM' if delamination has occurred between layers of the repair system

excluding delamination between the topcoat and the outermost undercoat (remember, this is topcoat delamination). The repair system is defined as any coating system which is applied on top of the original coating system. Therefore, if the original coating system has not been overcoated, delamination within repair system is not possible. A diagram of delamination wITHIN REPAIR SYSTEM is shown in Section 3.4

4. BETWEEN ORIGINAL/REPAIR - Mark an 'X' in the box beside 'BETWEEN ORIGINAL/REPAIR' if delamination has "occurred between the outermost coat of the original coating system and the innermost coat of the repair system. A diagram of delamination BETWEEN ORIGINAL/REPAIR is shown in Section 3.4.

5. WITHIN ORIGINAL SYSTEM - Mark an ' X' in the box beside 'WITHIN ORIGINAL SYSTEM' if delamination has occurred between any layers of the original coating system. A diagram of delamination WITHIN ORIGINAL SYSTEM iS shown in Section 3.4.

6. TO SHOP PRIMER - **Mark an 'X' in the box beside 'TO** SHOP PRIMER[1] if delamination has occurred between the innermost coat of the original coating system and the shop primer. A diagram of delamination TO SHOP PRIMER is shown in Section 3.4.

7. TO STEEL. SUBSTRATE - Mark an 'X' in the box beside 'TO STEEL SUB-STRATE' if all coatings have separated from the surface "of the hull leaving the bare steel exposed. A diagram of delamination TO STEEL SUBSTRATE is shown in Section 3.4:

B. BLISTERING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAM (diagrams and instructions for use in Section 3.1), enter the number of the diagram which

most closely approximates the overall extent of blistering. If there is no blistering in this inspection area, enter the number 'O' (zero), and ❑move down to 'C. CRACKING'.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT wITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of blistering within the affected area. Remember, if the OVEALL EXTENT box above is marked with a 'u' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. SIZE - Using the method described in ASTM 0714, enter the number which most closely approximates the size of the largest blister in the inspection area.

3. DENSITY - Using the method described in ASTM D714, enter the number which most closely approximates the highest blister density in the inspection area.

4. % BROKEN BLISTERS - Visually approximate the percentage of broken blisters and enter that number In the box to the right. If none of the blisters are broken, enter a zero.

To complete the next three selections of the inspection , the inspector must break open a few of the blisters using a knife or other sharp object.

5. ORGANIC ODOR IN BLISTERS? - When the blisters are broken, the inspector should note whether the blisters contain Liquid. If the blisters do contain liquid, the inspector should smell the liquid to determine if the liquid has an organic odor (i.e. ketone). If the liquid does have an organic odor, circle the 'Y',' next to 'ORGANIC ODOR IN BLISTERS ? ' . If there is no organic odor, or if the blisters do not contain liquid "circle the 'N' .

6. BLISTERS CONTAIN WATER? - If the blisters contain liquid and the liquid does not have an organic odor, circle the 'Y' next to ' BLISTERS CONTAIN WATER? ' . If none of the blisters contain liquid, circle the 'N'.

A. pH - If you circled ' Y' in response to ' BLISTERS CONTAIN WATER? ' , then determine the pH of the water using PH paper and enter the pH value in the box to the right of 'pH'.

7. CORROSION UNDER BLISTERS? - Look at the substrate beneath the blisters which have just been broken open. If any part of the substrate beneath these blisters is corroded, circle the 'Y' 'next to 'CORROSION UNDER BROKEN *BLISTERS? , .* If none of the substrate beneath these broken blisters is corroded, circle the 'N'.

C. CRACKING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. 1), enter the number of the diagram which most closely approximates the overall excent of cracking. If there is no cracking in this inspection area, enter the number 'O ' (zero), and move down to 'D. CHECKING'.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3. L), enter the letter of the diagram which most closely approximates the extent of cracking within the affected area. Remember, if the 0VERALL EXTENT box above is marked with a ' O' (zero) , leave the EXTENT WITHIN AFFECTED AREA box blank.

D. CHECKING

1. OVERALL EXTENT - Using the OVERALL EXTENT O DIAGRAMS (diagrams and

instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of checking. If there is no checking in this inspection area, enter the number 'O' **(zero),** and move down co 'E. FLAKING'.

a. EXTENT WITHIN AFFECTED AREA . Using the EXTENT WITHIN AFFECTED AREA diagrams (diagrams and instructions for use in section 3. 1), enter the letter of the diagram which most closely approximates the extent of checking within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

E. FLAKING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in SectiOn 3.1) , enter the number of the diagram which most closely approximates the overall extent of flaking. If there is no flaking in this inspection area, enter the number 'O ' (zero), and move down to 'F. SAGS OR CURTAINS ' ?

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3. 1), enter the letter of the diagram which most closely approximates the extent of flaking within che affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. SEVERITY - Use the photographic reference standard in ASTM D772 to determine the degree of flaking. Enter the number of the photographic reference standard (2, 4,6, or 8) which most closely approximates the degree of flaking on the inspection surface.

F. SAGS OR CURTAINS? - Sags or curtains can occur on a vertical surface when paint is applied too thickly. Gravity will cause the paint to move down the vertical surface to form either a continuous ridge across the surface (curtain) or a running stream down the surface (sag). If either sags or curtains have occurred, circle the 'Y'. If there is no evidence of sags or curtains, circle the 'N'.

G. EROSION? - Erosion is the wearing away of a paint film over a period of time to expose the substrate or undercoat. If erosion has occurred in the inspection area, circle the 'Y'. If there is no evidence of erosion , circle the 'N'.

H. KNIFE TEST - Using a craftman"s knife with a curved blade and holding the blade at a 30" angle to the substrate cut a narrow ribbon of coating from an undamaged portion of the inspection area.

1. ACCEPTABLE? - If the cut portion of the coating ribbons or delaminates between layers, circle the 'Y'. If there is no evidence of ribboning or delamination between layers, circle the 'N'. If 'N' is circled, identify the delamination layer by marking the appropriate boxed (A-F) below.

A. TOPCOAT - Mark an 'X' in the box beside 'Topcoat' if top coat delamination has occurred. Top coat delamination has occurred if only the outermost coating has separated from all undercoats. A diagram of TOPCOAT delamination is shown in Section 3. 4

B. WITHIN REPAIR SYSTEM - Mark an 'X' in the box beside 'WITHIN REPAIR SYSTEM' if delamination has occurred between layers of the repair system excluding delamination between the topcoat and the outermost undercoat (remember, this is topcoat delamination). The repair system is defined as

any coating system which is applied on top of the original coating system. Therefore,- if the original coating system has not been overcoated, delamination within repair system is not possible. A diagram of delamination WITHIN REPAIR SYSTEM is shown in Section 3.4

C. BETwEEN ORIGINAL/REPAIR - Mark an 'X' in the box beside ' BETwEEN ORIGINAL/REPAIR' if delamination has occurred between the outermost coat of the original coating system and the innermost coat of the repair system. A diagram of delamination BETWEEN ORIGINAL/REPAIR is shown in Section 3.4

D. WITHIN ORIGINAL SYSTEM - Mark an 'X' in the box beside 'WITHIN ORIGINAL SYSTEM' if delamination has occurred between any layers of the original coating system. A diagram of delamination WITHIN ORIGINAL SYSTEM is shown in Section 3.4

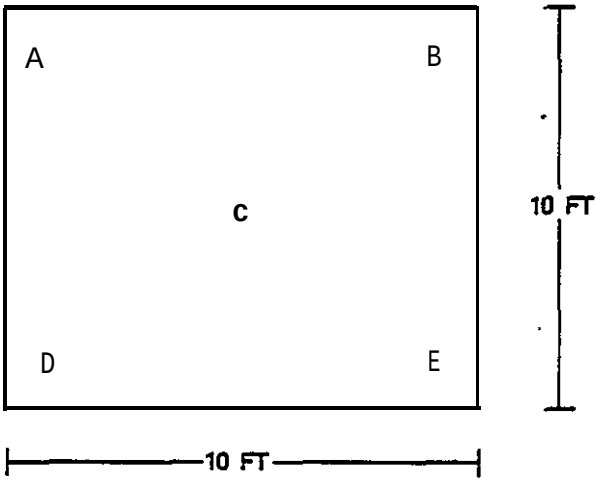
E. TO SHOP PRIMER - Mark an 'X' in the box beside 'TO SHOP PRIMER' if delamination has occurred between the innermost coat of the Original coating system and the shop primer. A diagram of delamination TO SHOP PRIMER is shown in Section, 3.4

F. TO STEEL SUBSTRATE - Mark an 'X' in the box beside 'TO STEEL SUB-STRATE' if all coatings have separated from the surface of the hull Leaving the bare steel exposed. A diagram of delamination TO STEEL SUBSTRATE is shown in Section 3.4

IV. MEASURED PROPERTIES

A. Dry Film Thickness - Dry film thickness (DFT) measurements are co be made using a properly calibrated magnetic gage. Measurements and calibration are to be performed in accordance with SSPC-PA-2. Five separate spot measurements with three readings in each spot area are to be made in each 10 ft x 10 ft

(100 square feet) area. This means that 15 individual readings will be made **in the** 100 square foot area (5 spot areas x 3 readings in each spot area = 15 total readings). The square below represents a 100 square foot area; the letters (A, B, C, D and E) represent the 5 spot areas; and the dots represent where each individual OFT measurement c should be made.



The five separate **spot measurements (15 individual** measurements shall be **made for** each **100** square feet of area as follows :

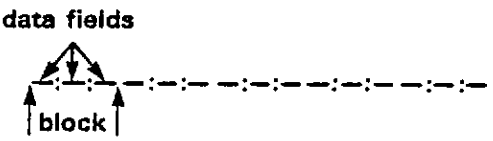
(L) If the entire inspection area does not exceed 300 square feet (30 ft x 10 ft), each 100 square foot area shall be measured.

(2) If the entire inspection area does not exceed 1000 square Feet (30 ft x 33 ft 4 in), three 100 square foot areas shall be randomly selected and measured.

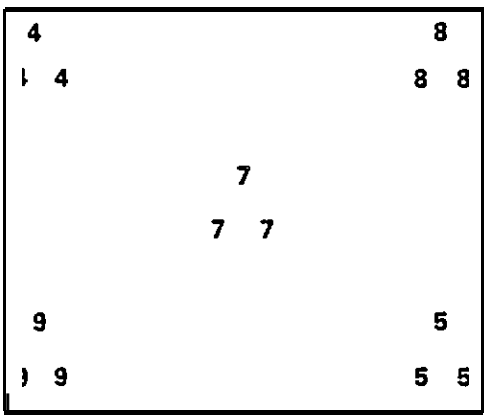
(3) If the entire inspection area exceeds 1000 square feet, the first 1000 square feet shall be measured as stated in (2) above and for each additional 1000 square feet of area or increment thereof, one 100 square foot area shall be randomly selected and measured.

The separate spots where DFT measurements are taken must. be clean and dry with an intact coating undamaged by fouling, corrosion, etc. If a separate spot is not suitable for DFT measurements, move to the nearest suitable location. If the entire inspection area is not suitable for DFT measurements leave all boxes blank.

Each line on the inspection from is intended to hold all of the readings for a 100 square foot area (15 readings). Notice that each line under 'A. DRY FILM THICKNESS (MILS)' is composed of five blocks with each block separated by a space. Each block is composed of three data fields with each data field separated by a '|'.



As previously mentioned, for each 100 square foot area, the inspector should make five spot measurements with three individual readings being taken in each spot. Each data field will hold one of the three individuals readings; a block will therefore be equivalent to one of the five spot measurements. For example, suppose that the square below represents a 100 square foot area and that each number represents a DFT measurement (five spots, three measurements per spot).



Enter the readings onto the inspection form as shown below.

IV. MEASURED PROPERTIES

A. DRY FILM THICKNESS (MILS)

4 4 4 8 8 8 7 7 7 9 9 9 5 5 5

There are enough lines present on the inspection form to hold readings for a 6000 square foot inspection area.

If the inspecting area is layer than 6000. square feet, circle the 'Y' next to '1. MORE DFT READINGS?' On a separate sheet of paper, enter all of the additional readings. Also include the AREA No. (of the inspection area), DATE, SHIP NAME, HULL NUMBER, and INSPECTOR'S NAME. If the inspecting area is not larger than 5000 square feet, circle the 'N' next to 'L. MORE DFT READINGS?'

B . SURFACE ROUGHNESS READINGS TAKEN? Surface roughness measurements are an optional criteria. If surface roughness measurements are made, circle the 'Y'; if not, circle the 'N'. If any surface roughness readings are taken, the methods and instrument (hull roughness analyzer) recommended by the British Ship Research Association are to be used.

v. DIELECTRIC SHIELDS - The inspector should inspect both the primary and secondary dielectric shields and answer ' yes ' ('Y') or 'no' ('N') to questions A-O, F and G. Measure the dry film thickness (DFT) of both the primary and secondary dielectric shields and record the results in the boxes next co 'E. DRY FILM THICKNESS ' . If only one dielectric shield is present, record answers under 'primary' (PRIM). Leave the columns under 'secondary' (SEC) blank.

A. BLISTERING? - If blistering is present, circle 'Y'. If there are no blisters, circle 'N'.

B. DELAMINATION? - If delamination is present, circle 'Y' . If there are no delamination , circle 'N'.

C. FOULING? If any type of fouling is present, circle 'Y'. If the dielectric shield is free of fouling, circle 'N'.

D. CORROSION

1. GENERAL - If general corrosion is present, circle 'Y'; otherwise circle 'N'.

2. PITTING - If pitting corrosion is present, circle 'Y' ; otherwise circle 'N'.

E. DRY FILM THICKNESS - Enter the DFT measurements in the appropriate box.

F. CALCAREOUS DEPOSIT? - If any calcareous (whir-e, calcium-Like) deposits are present, circle 'Y'. If none are present, circle 'N'.

G. EROSION? - If there is evidence of erosion, circle 'Y'. If no evidence 'on is present, circle 'N' .

ASTM Designation F2502-O1O2

STANDARD METHOD FOR INSPECTING THE COATING SYSTEM OF A SHIP ' S TANKS AND VOIDS

1. SCOPE

1.1 This method describes .a standard procedure for inspecting the coating system of a ship's tanks and voids. Included are a standard Inspection form to be used for reporting the inspection data and a series of diagrams which are used to report the extent of damage co the coating system. This method is intended for use only by an experienced marine coating inspector.

2. APPLICABLE DOCUMENTS

2.1 ASTM Standards

- o D714 Standard Method of Evaluating Degree of Blistering of Paints
- o D772 Standard Method of Evaluating Degree of Flaking (Scaling) of Exterior Paints

2.2 Steel Structures Painting Council (SSPC)

- 0 SSPC-PA-2 Measurement of Dry Paint Thickness with Magnetic Gages

3. REFERENCE STANDARDS

3.1 OVERALL EXTENT DIAGRAMS (Figure 1), EXTENT WITHIN AFFECTED AREA DIAGRAMS (Figures 2, and 3). The OVERALL EXTENT DIAGRAMS ' and ' EXTENT WITHIN AFFECTED AREA DIAGRAMS' are used to report the area covered by different types of

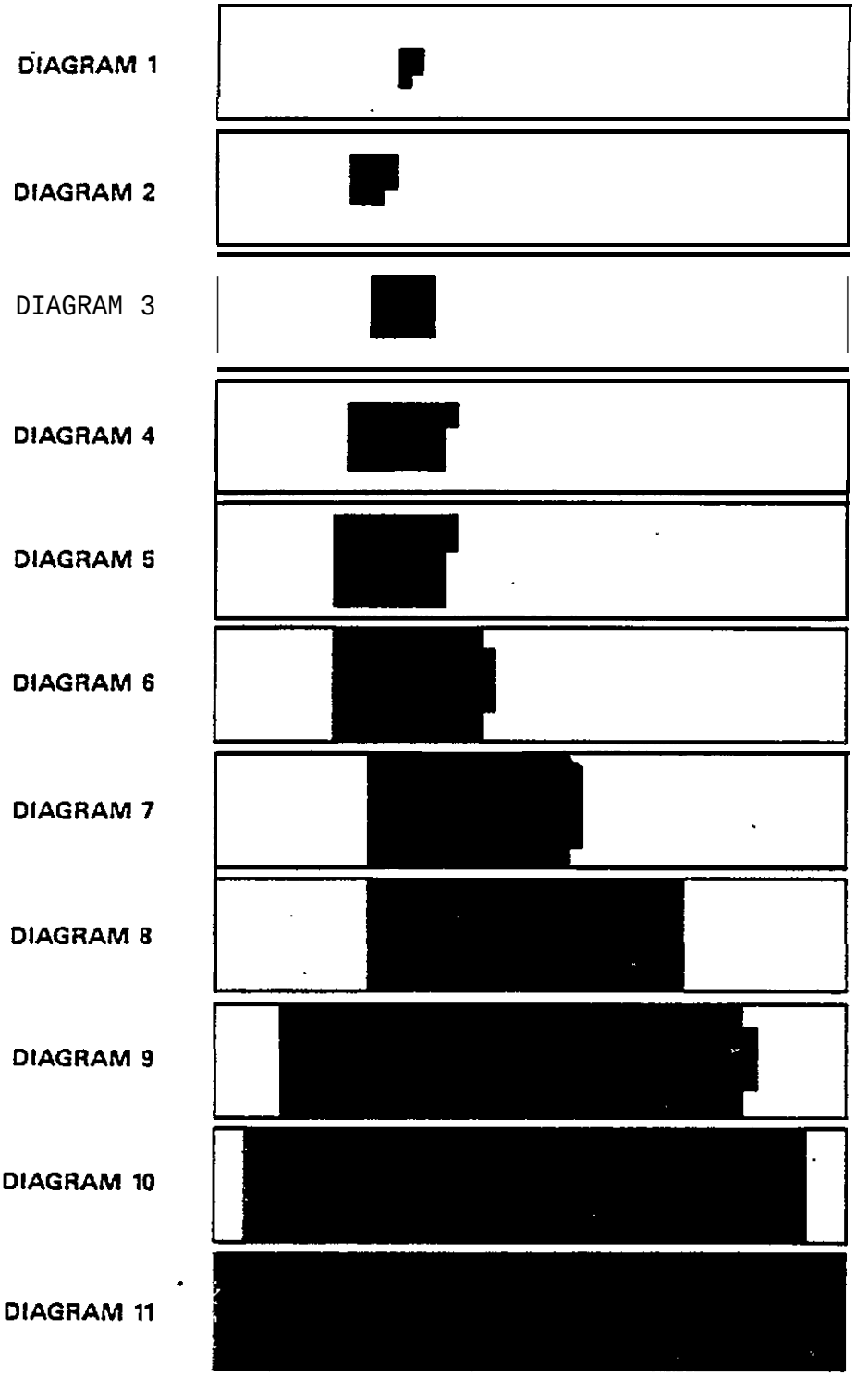


Fig. 1. Overall `extent` diagrams.

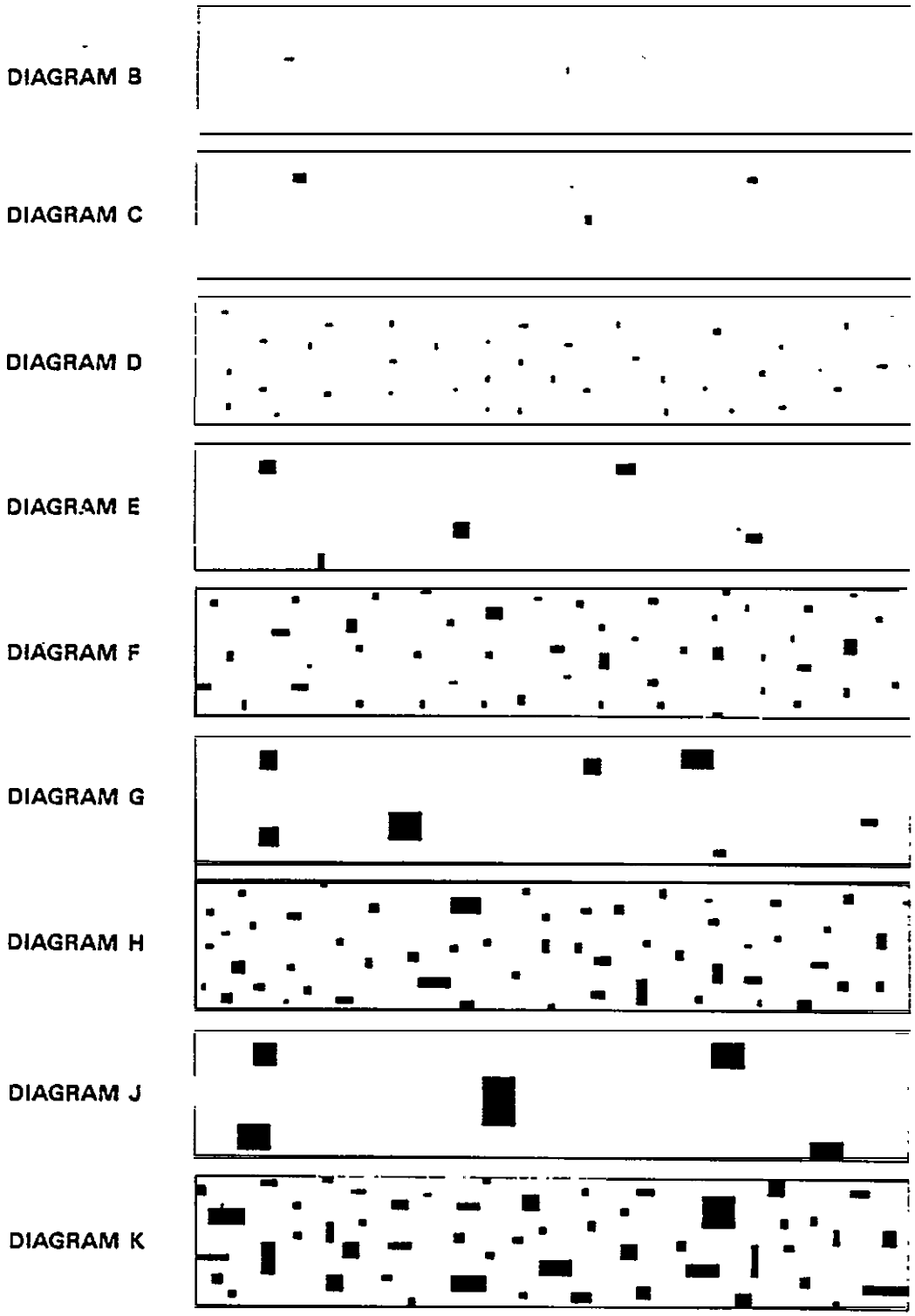


Fig. 2. Extent within affected area diagrams.

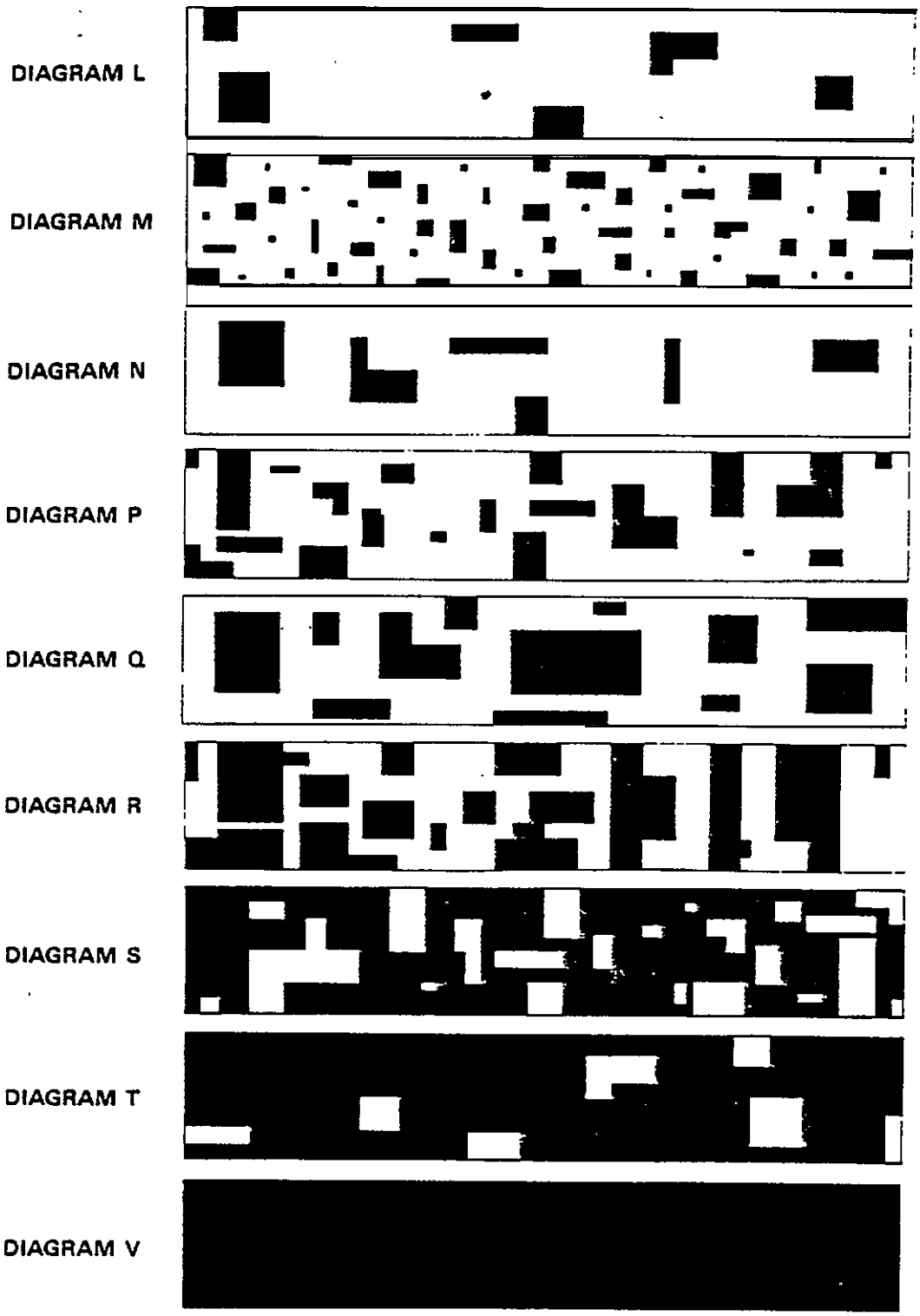
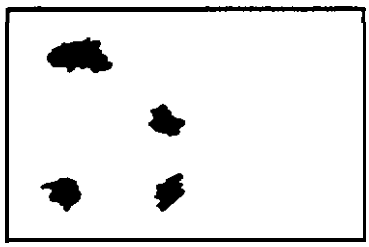


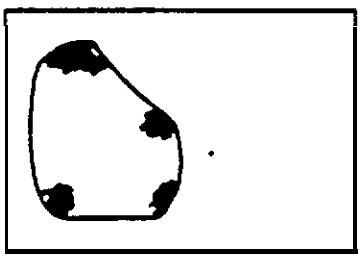
DIAGRAM L
DIAGRAM M
DIAGRAM N
DIAGRAM P
DIAGRAM Q
DIAGRAM R
DIAGRAM S
DIAGRAM T
DIAGRAM V

Fig. 3.

corrosion and paint failures. The 'OVERALL EXTENT DIAGRAMS ' are used first co group all areas where a particular type of damage has occured into one contiguous block. The 'EXTENT WITHIN AFFECTED AREA DIAGRAMS ' are then used co Identify the pattern of damage within chat contiguous block. For example, suppose you are inspecting for I.A (Corrosion General (see Figure 8)) and general corrosion appears distributed over the entire inspection area as shown by the black areas in the diagrams below.



The **first step is to draw an imaginary line which would enclose all of the** general *corrosion.* This enclosure should be **as small as possible.** Now select the diagram from the OVERALL EXTENT DIAGRAMS which most closely approximates the enclosed area with respect to the entire inspection area. Using the general corrosion example, the enclosed area (shaded area) would closely match Diagram 6.

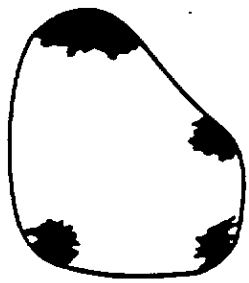


Enclosed Area

Diagram 6

Enter a '6' (for diagram 6) in the box next to 1.A. 1. OVERALL EXTENT in Figure 8.

The second step is to look at only the *enclosed area* and select the diagram *from* the EXTENT wITHIN AFFECTED AREA DIAGRAMS which most closely identifies the pattern of general corrosion in the enclosed area. In this example, Diagram N would be a good choice.



Enclosed Area

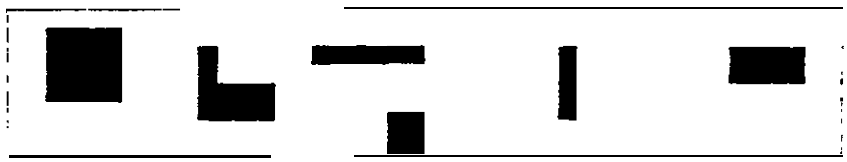


Diagram N

Enter an 'N' (for diagram N) in the box next co 1.A.l .A. EXTENT WITHIN AFFECTED AREA.

NOTE : Selection of diagrams is based on visual comparisons and therefore different inspectors may select different diagrams. However, the diagrams are designed to ❑minimize these differences and enhance reproducibility.

3.2 FORMS OF MECHANICAL DAMAGE

This reference standard (Figure 4) is a series of photographs used co identify the various forma of mechanical damage to a coating which can lead *to corrosion.*

3.3 TYPES OF CORROSION

This reference standard (Figure 5) is a series of photographs used to show examples of general corrosion, piecing corrosion, pin-point corrosion, corrosion along welds , and rust staining .

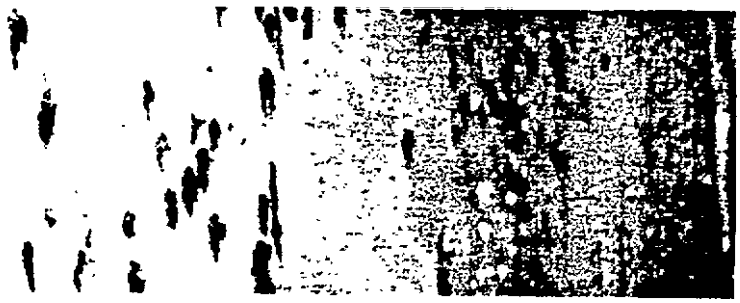
SCRAPING/
IMPACT

INTERNAL WELDS/
BURN MARKS

Fig.4. Forms of mechanical damage.

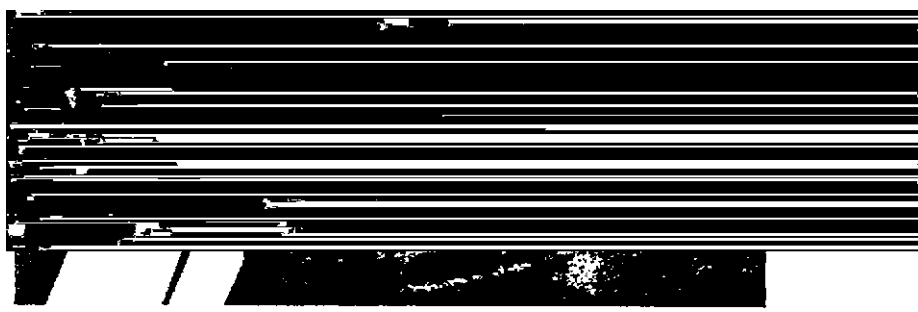
GENERAL
CORROSION

PITTING
CORROSION



PIN-POINT
CORROSION

CORROSION
ALONG WELDS



RUST STAINING

Fig. 5. Types of corrosion.

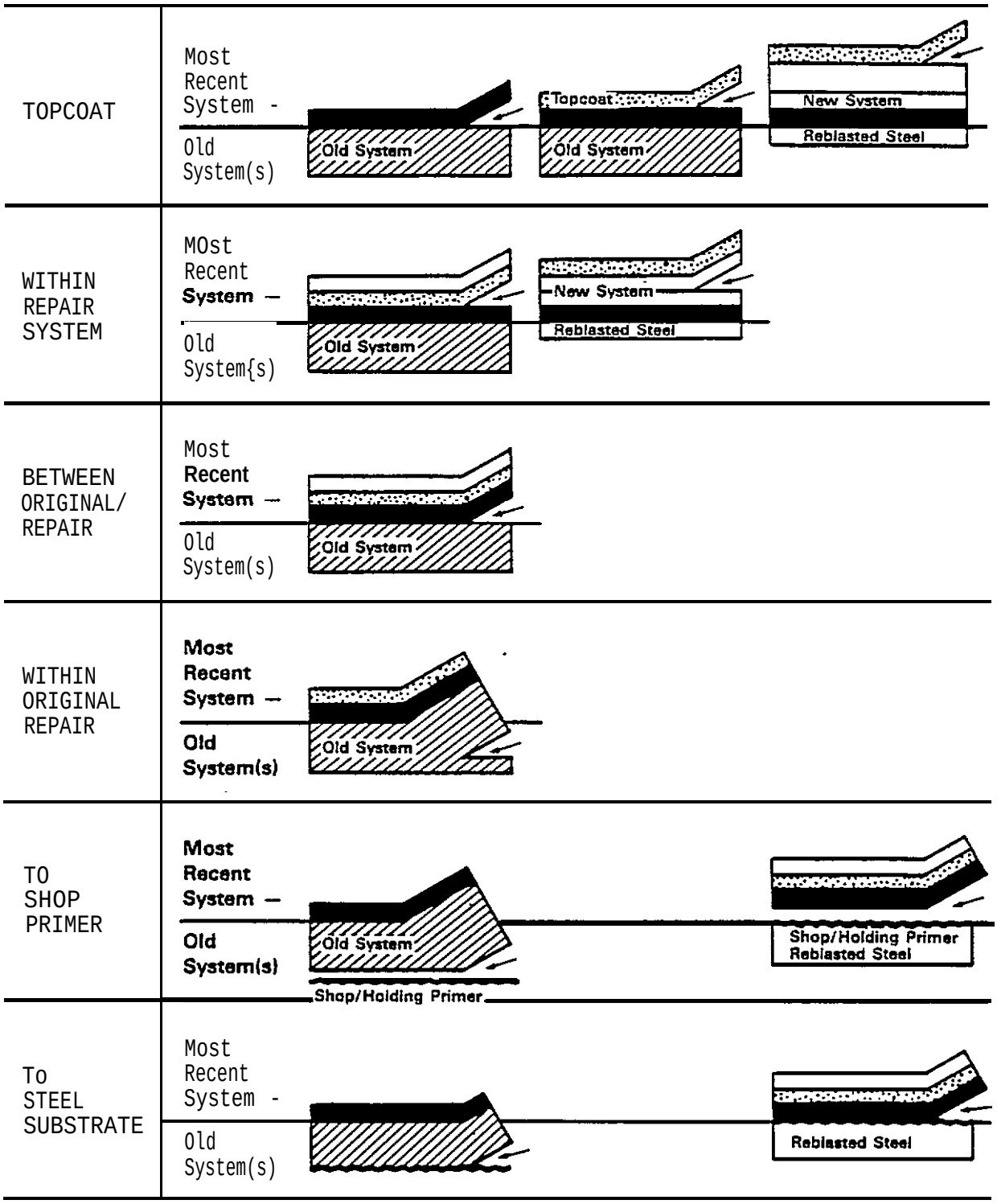


Fig. 6. Levels of delamination.

3 . 4 LEVELS OF DELAMINATION

This reference standard (Figure 6) is a series of diagrams which identifies the levels in a coating system where delamination can occur.

4. REQUIREMENTS

The inspector MUST know how to perform the follow tests :

4.1 Calibrate and use a magnetic guage co measure dry film thickness.

6.2 Use pH paper properly.

4.3 Use a camera properly.

4.4 Recognize the various types of corrosion , and forms of paint failures (blistering, delamination, etc.) .

4.5 Recognize the various tank areas as described in Figure 9.

5. PROCEDURE AND REPORTING

The inspection form consists of two pages to be completed by the inspector and four pages of reference standards. The first of the two pages to be completed by the inspector is shown in Figure 7. This Form, which iS Self-explanatory, requests general Information about the ship.

The second page of the inspection form co be completed by the inspector is shown in Figure 8. The each tank hull is divided into seven inspection areas. These seven inspection areas are defined by the diagram in Figure 9. For each of the inspection areas delineated in Figure 9, the inspector is to complete a separate Inspection form (shown in Figure 8) . Therefore, for each complete tank inspection, the inspector must complete seven of the forms shown

STANDARDIZED INSPECTION - TANKS AND VOIDS

A. NAME OF VESSEL AND HULL NUMBER

B. LOCATION (SHIPYARD)

c. IDENTIFICATION OF LAST COATING SYSTEM APPLIED (MANUFACTURER AND I. D.)

_____

D. ADDITIONAL COMMENTS:

_____

_____

_____

_____

_____

_____

_____

E, INSPECTOR'S SIGNATURE _____

F, INSPECTOR'S NAME (PRINT) _____

G. INSPECTION DATE _____

Fig. 7.

AREA NO. _____ DATE _____

SHIP NAME _____

HULL NUMBER _____

INSPECTOR'S NAME _____

REQUIRED PHOTOGRAPHS
1. ENTIRE AREA
2. CLOSE-UP OF ALL DAMAGE

INSPECTION AREA OBSCURED? Y N

I. CORROSION
A. GENERAL
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA

B. MECHANICAL DAMAGE
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA
2. TYPE OF DAMAGE
A. SCRAPING/IMPACT
B. INTERNAL WELDS/BURN MARKS

C. PITTING CORROSION
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA

D. PIN-POINT CORROSION
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA

E. CORROSION ALONG WELDS? Y N

F. RUST STAINING? Y N

II. PAINT CONDITION
A. DELAMINATION
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA
2. TOPCOAT
3. WITHIN REPAIR SYSTEM
4. BETWEEN ORIGINAL/REPAIR
5. WITHIN ORIGINAL SYSTEM
6. TO SHOP PRIMER
7. TO STEEL SUBSTRATE
8. ORGANIC ODOR FROM DELAM. AREA? Y N
9. SAMPLE TAKEN? Y N

B. BLISTERING
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA
2. SIZE (ASTM D714)
3. DENSITY (ASTM D714)
4. % BROKEN BLISTERS
5. ORGANIC ODOR IN BLISTERS? Y N
6. BLISTERS CONTAIN WATER? Y N
A. pH
7. CORROSION UNDER BLISTERS? Y N

Fi

C. CRACKING
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA

D. CHECKING
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA

E. FLAKING
1. OVERALL EXTENT
A. EXTENT WITHIN AFFECTED AREA
2. SEVERITY

F. SAGS OR CURTAINS? Y N

G. CHALKING? Y N

H. DISCOLORATION? Y N

I. SOFTENING? Y N

J. VALVES, PIPING, HEATING COILS PRESENT? Y N
1. COATING DAMAGE IN ADJACENT AREAS? Y N

K. STIFFENERS PRESENT? Y N
1. COATING DAMAGE BEHIND STIFFENERS? Y N

L. ANODES PRESENT? Y N
1. COATING DAMAGE IN ADJACENT AREAS? Y N
2. ANODES FUNCTIONING? Y N

M. KNIFE TEST
1. ACCEPTABLE? Y N
IF 'N', MARK LEVEL(S) BELOW
A. TOPCOAT
B. WITHIN REPAIR SYSTEM
C. BETWEEN ORIGINAL/REPAIR
D. WITHIN ORIGINAL SYSTEM
E. TO SHOP PRIMER
F. TO STEEL SUBSTRATE

III. MEASURED PROPERTIES
A. DRY FILM THICKNESS

1. MORE DFT READINGS? Y N

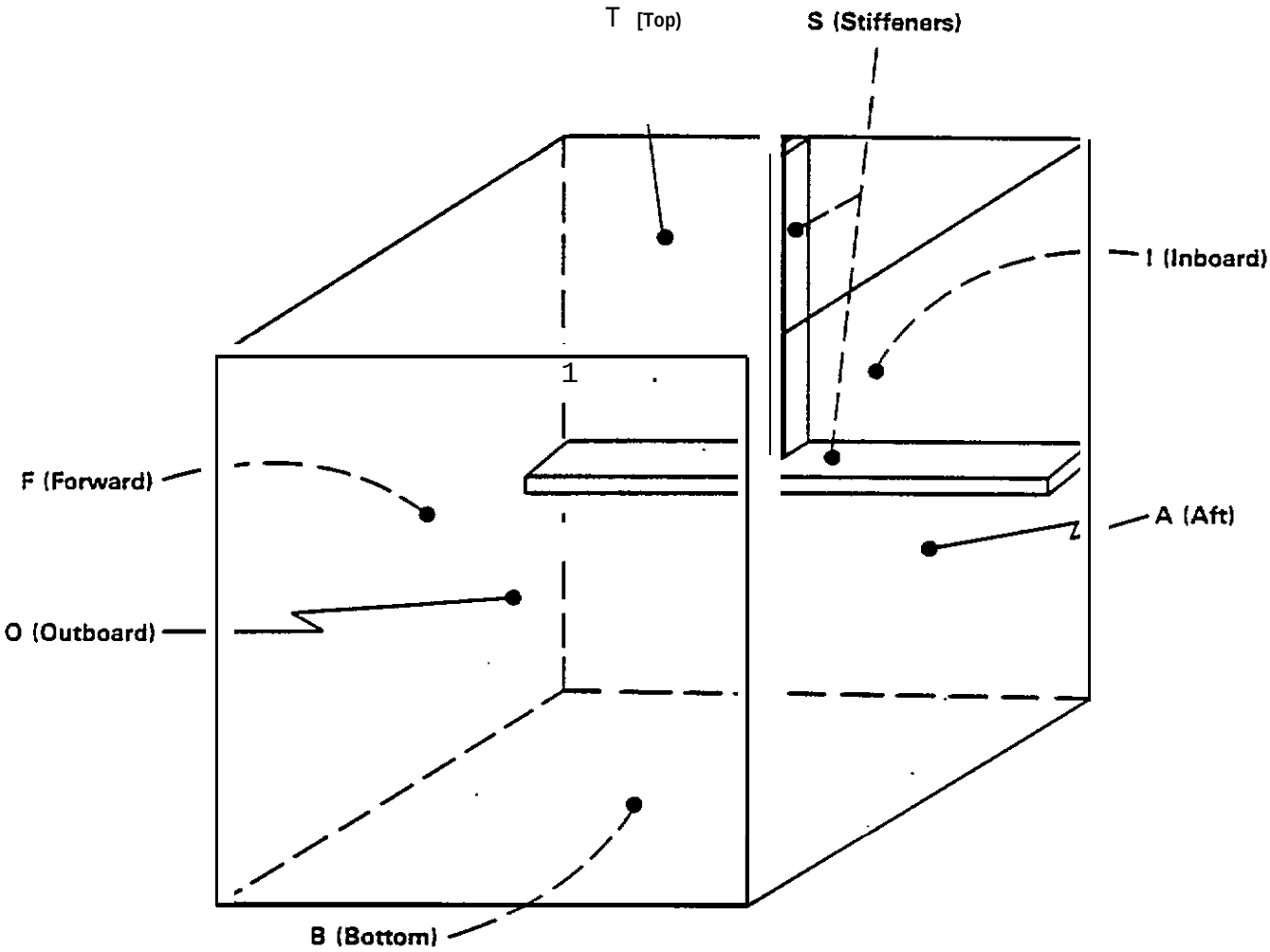


Fig. 9. Standardized inspection – tanks and voids.

in Figure 8. Detailed instructions for completing the form shown in Figure 8 are given- below.

AREA NO. - The tank is segmented into seven distint Inspection areas. Enter the code for the area being inspected. For example, enter 'B ' for the bottom of tank inspection 'A' , for the aft bulkhead, etc. A complete List of tank segments and their codes is shown in Figure 9.

DATE - Enter the date of the inspection. If the inspection requires more than one day, enter the date the inspection is completed.

SHIP NAME - Enter the ship's name (Eg. USS TRENTON).

HULL NUMBER - Enter the hull number of the ship (Eg. LPD-14).

INSPECTOR'S NAME - The inspector should print his name.

REQUIRED PHOTOGRAPHS - For each inspection area, a photograph of the entire area is required. If the area is too large co capture in one photograph, the area should be divided into equally-sized segments and each segment should be photographed. An individual close-up photograph of each damaged section in the inspection area is required. Each photograph should be marked with the Area No., Ship Name, and Date. Also, a 'size scale' should be captured in each photograph so that the size of the area can be determined.

INSPECTION AREA OBSCURED? If the inspection area is completely obscured and cannot be inspected, circle the 'Y' . This condition of being completely obscured will probably occur most frequently in the Bottom inspection area ('B') where dirt and other contaminants have settled. If the inspection area is not completely obscured, circle the 'N' .

I. CORROSION

The. inspector should distinguish between four types of corrosion and report each type separately. The four types of corrosion are:

l.. GENERAL CORROSION - General corrosion, for the purposes of this inspection form, is all corrosion which is not covered in the mechanical damage, pitting corrosion, or pin-point corrosion sections below. Patches of common, ordinary rusting are classlified as general corrosion.

2. MECHANICAL DAMAGE - Mechanical damage corrosion is corrosion that occurred because the paint was removed from the hull by some type of scraping or lmpact against the hull. With the paint removed and the steel hull exposed co sea water, corrosion occurred. Photographic examples of corrosion due to various forms of mechanical damage (i.e. grounding, scraping/impact, anchor chains/ropes, internal welds/ burning and scrubbing) are shown in section 3.2.

3. PITTING CORROSION - Pitting corrosion is a more advanced form of Localized corrosion. Pitting corrosion is characterized by visible indentations or pits which have penetrated into the steel hull surface. These pits distinguish between pitting corrosion and general corrosion , the Latter being characterized by a Layer of rust which does not penetrate Locally in to the surface but is more uniform in extent. A photographic example of piecing corrosion is shown in section 3.3.

4. PIN-POINT CORROSION - Pin-point corrosion is characterized by a pattern of small spots (pin-points) of rust. A photographic example of pin-Point corrosion is shown in section 3.3.

A. GENERAL

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the *overall extent* of general corrosion. If there is no general corrosion *in* this inspection area, enter the number '0 ' (zero) , and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - using the EXTENT WITHIN AFFECTED AREA DIAGRAMS **(diagrams and instructions for use In section 3.1), enter the Letter** of the diagram which most closely approximates the extent of general corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

B. MECHANICAL DAMAGE

1. 0VERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of corrosion due co mechanical damage. If there is no corrosion due to mechanical damage in this inspection *area, enter* the number ' 0' (*zero),* and leave the next box (EXTENT WITHIN AFFECTED AREA) 00blank.

a. EXTENT WITHIN AFFECTED **AREA** - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of corrosion due co mechanical damage within the affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. TYPE OF DAMAGE - If corrosion due to mechanical damage has occurred, use the photographic examples in section 3.2 co identify the type of mechanical damage which has occurred. On the inspection form, mark an 'X' in the box next co the type of damage (i.e. scraping/ impact, internal welds/burn marks) which has occurred.

C . PITTING CORROSION

1. 0VERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. 1), enter the number of the diagram which **most closely approximates the overall extent of piecing corrosion.** If there is no pitting corrosion due co mechanical damage in this inspection area, enter the number 'O' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in Section 3. 1) , enter the Letter of the diagram which most closely approximates the extent of pitting corrosion whichin the affected area. .Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), Leave the EXTENT WITHIN AFFECTED AREA box blank.

D. PIN-POINT CORROSION

1. OVERALL EXTENT - Using the OVERALL EXTENT. DIAGRAMS (diagrams and inscructions for use in Section 3. 1), enter the number of the diagram which most closely approximates the overall extent of pin-point corrosion. If there is no pin-point corrosion due to mechanical damage in this inspection area, enter the number 'O' (zero), and Leave the next box (EXTENT WITH AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1) , enter the letter of the diagram which mast closely approximates the extent of pin-point corrosion with the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero) , Leave the EXTENT WITHIN AFFECTED AREA box blank.

E. CORROSION ALONG WELDS? - Corrosion is prevalent along the welds in tanks and voids. The inspector should check all welds and circle 'Y' if any weld or any area immediately adjacent co a weld is corroded. If all welds and adjacent areas are free of corrosion, circle the 'N' .

F . RUST STAINING? - Ruse staining is a brownish, rust-colored discoloration which occurs when Loose ruse particles are carried by water across a painted surface and are absorbed into the paint giving a brownish *Stain. It is* impOrtant co distinguish between rust staining which is simply a discoloration, and corrosion which is a paint failure. [f rust staining has occurred in the inspection area, circle the 'Y' . If no ruse staining has occurred circle the 'N'.

II. PAINT CONDITION

A. DELAMINATION - *Delamination is* characterized by detachment of the coating from the substrate or by a layer separation between the coats OF paint.

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. L), enter the number of the diagram which most closely approximates the overall extent of delamination. If there is no delamination in this Inspection area, enter the number 'O [1] (zero) , and move down to B. BLISTERING.

a. EXTENT WITHIN AFFECTED AREA -Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and inscructions for use in section 3.1), enter the Letter of the diagram which most closely approximates the extent of delamination within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. TOPCOAT - Mark an 'X' in the box beside 'TOPCOAT' of top coat delamination has occurred. Top coat delamination has occurred if only the outermost coating has separated from all undercoats. A diagram of TOPCOAT

3. WITHIN REPAIR SYSTEM - Mark an 'X' in the box beside 'WITHIN REPAIR SYSTEM' if **delamination has occurred** between layers of the repair system excluding delamination between the topcoat and the outermost undercoat (remember, this is topcoat delamination). The repair system is defined as any coating system which is applied on cop of the original coating system. Therefore, if the original coating system has not been overcoated, delamination within repair system is not possible. A diagram of delamination WITHIN REPAIR SYSTEM is shown in Section 3.4

4. BETWEEN ORIGINAL/REPAIR - Mark an 'X' in the box beside 'BETWEEN ORIGINAL/REPAIR' if delamination has occurred between the outermost coat of the original coating system and the innermost coat of the repair system. A diagram of delamination BETWEEN ORIGINAL/REPAIR is shown in Section 3.4 ~

5. WITNIN ORIGINAL, SYSTEM - Mark an 'X' in the box besid 'WITHIN ORIGINAL SYSTEM' if "delamination has occurred between any Layers of the original coating system. A diagram of delamination WITHIN ORIGINAL SYSTEM is Shown in Section 3.&.

6. TO SHOP PRIMER- Mark an 'X' in the box beside 'TO SHOP PRIMER' if delamination has occurred between the innermost coat of r-he original coating system and the shop primer. A diagram of delamination TO SHOP PRIMER is shown in Section 3.4.

7. TO STEEL SUBSTRATE - Mark an 'X' in the box beside 'To STEEL SUBSTRATE' if all coatings have separated from the surface of the hull leaving the bare steel exposed. A diagram of delamination TO STEEL SUBSTRATE is shown in Section 3.4.

8. ORGANIC ODOR FROM DELAMINATION AREA? - The Inspector should determine if there is an organic odor emanacting from the delaminated area. If there is an odor from an organic solvent (such as MEK or hi-flash naphtha), circle the 'Y'. If there is no organic odot, circle the 'N'.

9. SAMPLE TAKEN? If samples are taken, circle the 'Y' ; if not, circle the 'N'. Samples may be taken by removing some of the delaminated paint "chips and placing them into a small container. The container should be labelled with the AREA NO. SHIP NAME and NUMBER, OATS, and INSPECTOR' S NAME.

B. BLISTERING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. 1) , enter the number of the diagram which most closely approximates the overall extent of blistering. If there is no blistering in this inspection area, enter the number 'O' (zero), and move down to 'C. CRACKING' .

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT w ITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3. 1) , enter the Letter of the diagram which most closely approximates the extent of blistering

with in the affected area. Remember, If the OVERALL EXTENT box above is marked with a 'U' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. SIZE - Using the method described in ASTM D714, enter the number which most closely approximate the *size* of the largest blister in the Inspectin area.

3. DENSITY - Using the method described in ASTM 0714, enter the number which most closely approximate the highest blister density in the inspection area.

4. BROKEN BLISTERS - Visually approximate the percentage of broken blisters and enter thatv number in the box co the right. If none of the blisters are broken, enter a zero.

To complete the next three selections of the Inspection, the Inspector muse break open a few of the blisters using a knife or other sharp object.

5. ORGANIC 0DOR IN BLISTERS? - When the blisters are broken, the inspector should note whether the blisters contain liquid. If the blisters. do contain liquid, the Inspector should smell the liquid co determine if the liquid has an organic odor (i.e. ketone). If the liquid does have an Organic odor, circle the '.Y' next to 'ORGANIC ODOR IN BLISTERS? ,. IF there is no organic odor, or if the blisters do not contain liquid circle the 'N' .

6. BLISTERS. CONTAIN WATER? - If the blisters contain Liquid and the liquid does not have an organic odor, circle the 'Y* next co * BLISTERS CONTAI WATER? v . If none of the blisters contain liquid, circle the 'N'.

A. pH - If you circled 'Y' in response to ' BLISTERS CONTAIN WATER? , , then determine the PH of the water using pH paper and enter the pH value IN the box to the right of 'pH'.

7. CORROSION UNDER BLISTERS? - Look at the substrate beneath the blisters which have just been broken open. If any part of the substrate beneath these blisters is corroded, circle the 'Y' next to 'CORROSION UNDER BROKEN BLISTERS? . If none of the substrate beneath these broken blisters is corroded, circle the 'N'.

C. CRACKING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. L), enter the number of the diagram which most closely approximates the overall extent of cracking. If there is no cracking in this inspection area, enter the number '0 ' (zero) , and move down co 'D. CHECKING'.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA D[AGRAMS (diagrams and instructions for use in section 3.1), enter the *Ietter*$_{er}$ *of* the diagram which most c closely approximates the extent of cracking within the affected area. Remember, if the OVERALL EXTENT box above is marked" with a '0' (zero), Leave the EXTENT WITHIN AFFECTED AREA box blank.

D. CHECKING

1. OVERALL EXTENT - Using the' OVERALL EXTENT DIAGRAMS (diagrams and INSTRUCITONS for use in Section 3. 1) , enter the number of the diagram which most closely approximates the overall extent of checking. If there 1s no checking in this inspection area, enter the number '0 ' (zero) , and move down to 'E. FLAKING'.

a. EXTENT WITHIN AFFECTED .AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3. 1.), enter the lett$_{er}$ of the diagram which most closely approximates the extent of checking within the affected area. Remember, if the oVERALL EXTENT box above is ❑ marked with

a ‘0’ (zero), Leave the EXTENT WITHIN AFFECTED AREA” box blank.

E. FLAKING

1. OVERALL EXTENT - Using the OVERALL EXTENT (diagrams and Instructions for use in Section 3.1), enter the number of the diagram which nest closely approximates the overall extent of flaking. If there is no flaking in this inspection area, enter the number ‘ O‘ (zero), and move down to ‘F. SAGS OR CURTAINS? ‘ .

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the Letter of the diagram which most closely approximates the extent of flaking within the affected area. Remember, if the OVERALL EXTENT box above is marked with a ‘O’ (zero), Leave the EXTENT WITHIN AFFECTED AREA box blank.

2. SEVERITY - Use the photographic reference standard in ASTM D772 co determine the degree of flaking. Enter the number of the photographic reference standard (2,4,6, or 8) which most closely approximates the degree of flaking on the inspection surface.

F. SAGS OR CURTAINS? - Sags or curtains can occur on a vertical surface when paint is applied too thickly. Gravity will cause the paint co move down the vertical surface to form either a continuous ridge across the surface (sag) or a cunning scream down the surface (curtain). If either a sag or a curtain has occurred, circle the 'Y'. If there is no evidence of sags or curtains , circle the ‘N’.

G. CHALKING?- Chalking is characterized by the presence of loose removable powder, evolved from the paint film itself, at or just beneath the surface.

Chalking may be detected by rubbing the fingertips across the film. If chalking is present, circle the ' Y'. If there is no evidence of chalking, circle the 'N'.

H. DISCOLORATION? - Discoloration is characterized by a brown or black stain in the paint film which occurred because the tank was carrying fuel. Usually, there will be a line across the vertical surfaces of the tank below which discoloration has occurred and above which there is no discoloration. This line would be left by the level of fuel in the tank. If DISCOLORATION is present, circle the 'Y'. If there is no DISCOLORATION, circle the 'N' .

SOFTENING? Softening can be the result of organic fuel cargo. softening can be detected by pressing the edge of your fingernail into the paint film. If an impression is made, circle the 'Y'. If your fingernail does not penetrate the surface, SOFTENING has not occurred and the 'Y' should be circled.

J. VALVES, PIPING, HEATING COILS PRESENT? - If valves, piping, or heating. coils are attached co or supported from the inspection area surface, circle 'Y' . If no valves, piping, or heating coils are attached to or supported from the inspection area surface, circle 'N t and move down to 'K. STIFFENERS PRESENT? .

1. COATING DAMAGE IN ADJACENT AREAS? If valves, piping, or heating coils are present, the inspector should examine the adjacent painted areas. If any damage (i.e. delamination, blistering, *corrosion,* etc.) to the paint system has occurred, circle the ' Y'. If there is no damage to the paint, *circle* the 'N' .

K. STIFFENERS PRESENT? - Horizontal and vertical sciffners are structural supports which may be present in the tank to. add strength and rigidity. [f stiffeners are attached to the inspection area surface, circle the 'Y' . If

stiffeners are not present, circle the 'N'. If stiffeners are *not* present, circle the 'N' and move down co 'L. ANODES PRESENT? '.

L. COATING DAMAGE BEHIND STIFFENERS? - If stiffeners are present, the inspector should examined the adjacent painted area. [f any damage (i.e. delamination, blistering, corrosion, etc.) *to* the paint system has occurred, circle the 'Y'. If there is no damage co the paint, circle the 'N'.

L. ANODES PRESENT? If anodes are attached to the inspection area surface circle the 'Y'. If there are no anodes attached to the inspection area surface, circle the 'N' and move down to 'N. KNIFE TEST, .

1. COATING DAMAGE IN ADJACENT .AREAS? - If anodes present, the inspector should examine the adjacent painted areas. If any damage (i.e. delamination, blistering, corrosion, etc) to the paint system has occurred, circle the 'Y'. If there is no damage co the paint, circle the 'N' .

2. ANODES FUNCTIONING? There two situations when the anode can be said to be functioning: (a) If the anode itself is corroded and has lost mass and shape, and (b) if both the anode itself and all surfaces in the tank are completed free of corrosion. If either of these *situations* exists , circle the 'Y'. The anode is not functioning if corrosion is present on the tank surfaces but the anodes itself is free of corrosion (Note: Do not confuse superficial dirt on the anode with corrosion.) In this Latter situation, circle the 'X'.

M. KNIFE TEST - Using a craftman' s knife with a curved blade and holding the blade at a 30' angle co the substrate cut a narrow ribbon of coating from an undamaged portion of the inspection area.

1. ACCEPTABLE? - If the cut portion of the coating ribbons or delaminates between layers; circle the 'Y'. If there is no evidence of ribboning or delaminates between layers, circle the 'N'. If 'N' is circled, identify the delamination layer by marking the appropriate boxed (A-F) below.

A. TOPCOAT - Mark an 'X' in the box beside 'Topcoat ' if cop coat delamination has occurred. Top coat delamination has occurred if only the outermost coating has separated from all undercoats. A diagram of TOPCOAT delamination is shown in' Section 3.4

B . WITHIN. REPAIR SYSTEM - Mark an 'X' in the box beside 'WITHIN REPAIR SYSTEM' if delamination has occurred between layers of the repair system excluding delamination between the topcoat and the outermost undercoat (remember, this is topcoat delamination). The repair system is defined as any coating system which is applied on cop of the original coating system. Therefore, if the original coating system has not been overcoaced, delamination within repair system is not possible. A diagram of delamination WITHIN REPAIR SYSTEM is shown in Section 3.4

C. BETWEEN ORIGINAL/REPAIR - Mark an 'X' in the box beside ' BETWEEN ORIGINAL/REPAIR' if delamination has occurred between the outermost coat of the original coating system and the innermost coat of the repair system. A diagram of delamination BETWEEN ORIGINAL/REPAIR is show in Section 3.4

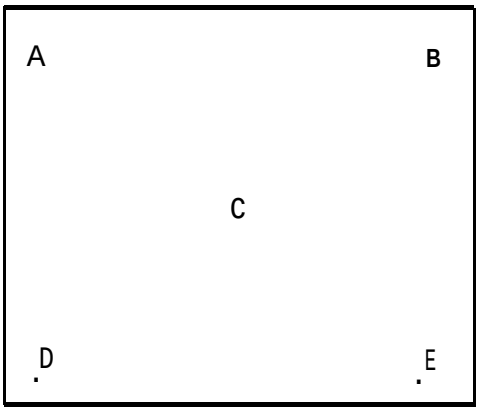
D. WITHIN 0RIGINAL SYSTEM - Mark an ' X' in the box beside 'WIThIN ORIGINAL SYSTEM' if. delamination has occurred between any layers of the original coating - system. A diagram of delamination WITHIN ORIGINAL SYSTEM is shown in Section 3.4

E. TO SHOP PRIMER - MARK an 'X' in the box beside 'TO SHOP PRIMER if delamination has occurred between the innermost coat of the original coating system and the shop primer. A diagram of delamination TO SHOP PRIMER is, shown in Section 3.4

F. TO STEEL SUBSTRATE - Mark an 'X' in the box. beside 'TO STEEL SUBSTRATE' lf all coatings have separated from the surface of the hull leaving the bare steel exposed. A diagram of delamination TO STEEL SUBSTRATE is shown in Section 3.4

IV. MEASURED PROPERTIES

A. Dry Film Thickness - Dry film thickness (DFT) measurements are to be made using a properly calibrated magnetic gage. Measurements and calibration are to be performed in accordance with SSPC-PA-2. Five separate spot measurements with three readings in each spot area are co be made in each 10 ft x 10 ft **(100 square feet)** area. This means that 15 individual readings will be made in the 100 square foot area (5 spot areas x 3 readings in each spot area = 15 total readings). The square below represents a LOO square foot area; the letters (A, B, C, D and E) represent the 5 spot areas; and the dots represent where each individual OFT measurement should be made.



The five separate SPOt measurements (15 individual measurements) shall be made for each 100 squace feet of area as follows:

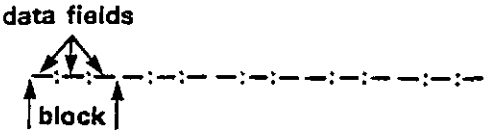
(1) If the entire inspection area doee not exceed **300** square feet (30 ft x 10 fc), each 100 square foot area shall be measured.

(2) If the entire inspection area does noe exceed 1000 square feet (30 fc **x 33** fc 4 in), three 100 square foot areas shall be randomly selected and measured.

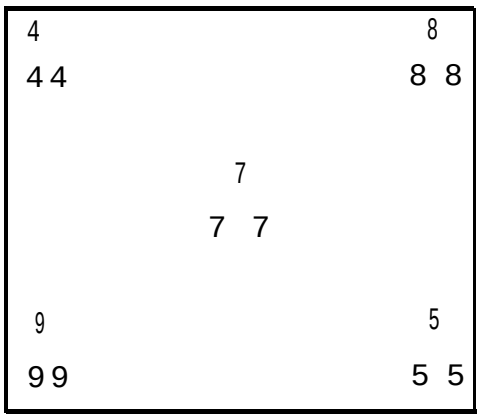
(3) If the entire inspection area exceeds 1000 square feet, che first 1000 square feet shall be measured as scaced in. (2) above and for each additional 1000 square feet of area or fncremenc thereof, one 100 square foot area shall be randomly selected and measured.

The separate spots where DFT measurements are taken ▫ust clean and dry with an incacc coating undamaged by fouling, corrosion, etc. [f a separate spot is noc suitable for OFT measurements , move co the nearest suitable **Location.** If the eneire inspection area is not suitable for OFT measurements **leave all** boxes blank.

Each line on che Inspection is intended to hold all of the readings for a LOO square faae area (L5 readings). Notice chac each Line under 'A. DRY FILM TSICSNESS (M2LS)' is composed of five blocks with each block separated by a space. Each block is composed of three data fields with each data field **separated by a ':'.**



AS previously mentioned, for each 100 square foot area, the inspector should make five spot measurements with three individual readings being taken in each spot. Each data field will hold one of the three individuals readings; a block will therefore be equivalent to one of the five SPOt measurements. For example, suppose that the square below represents a LOO square foot area and that each number represents a DFT measurement (five spots. three measurements per *sPOC).*



Enter the readings onto the inspection form as shown below.

IV. MEASURED PROPERTIES
A. DRY FILM THICKNESS (MILS)
4 4 4 8 8 8 7 7 7 9 9 9 5 5 5

There are enough lines present on the inspection form co hold readings for a 6000 square foot inspection area.

If the inspection area is larger than 6000 square feet, circle the 'Y' next to '1. **MOSS** DFT READINGS?' On a separate sheet of paper, enter all of the additional readings. Also include the AREA NO. (of the inspection area), OATS, SHIP NAME, HULL NUMBER, and INSPECTOR' S NAME. If the inspection area Tis not larger than 6000 square feet, circle the 'N' next to '1 . MORE DFT READING?'

ASTM Designation F2502-0103

STANDARD METHOD FOR INSPECTING THE COATING SYSTEM OF A SHIP'S DECKS AND DECK MAcHINERY

1. SCOPE

1.1 This method describes a standard procedure for inspecting the coating system of a ship's decks and deck machinery. Included are a standard inspection form to be used for reporting the inspection data and a series of diagrams which are used to report the extent of damage to the coating system. This method is intended for use only by an experienced *marine coating* inspector.

2. APPLICABLE DOCUMENTS

2.1 ASTM Standards

- o D714 Standard Method of Evaluating Degree of Blistering of Paints
- o D772 Standard Method of Evaluating Degree of Flaking (Scaling) of Exterior Paints

2.2 Steel Structures Painting Council (SSPC)

- o SSPC-PA-2 Measurement of Dry Paint Thickness with Magnetic Gages

3. REFERENCE STANDARDS

3.1 oVERALL EXTENT DIAGRAMS (Figure 1), EXTENT WITHIN AFFECTED AREA DIAGRAMS (Figures 2, and 3). The 'OVERALL EXTENT DIAGRAMS' and 'EXTENT WITHIN AFFECTED AREA DIAGRAMS' are used to report the area covered by different types of

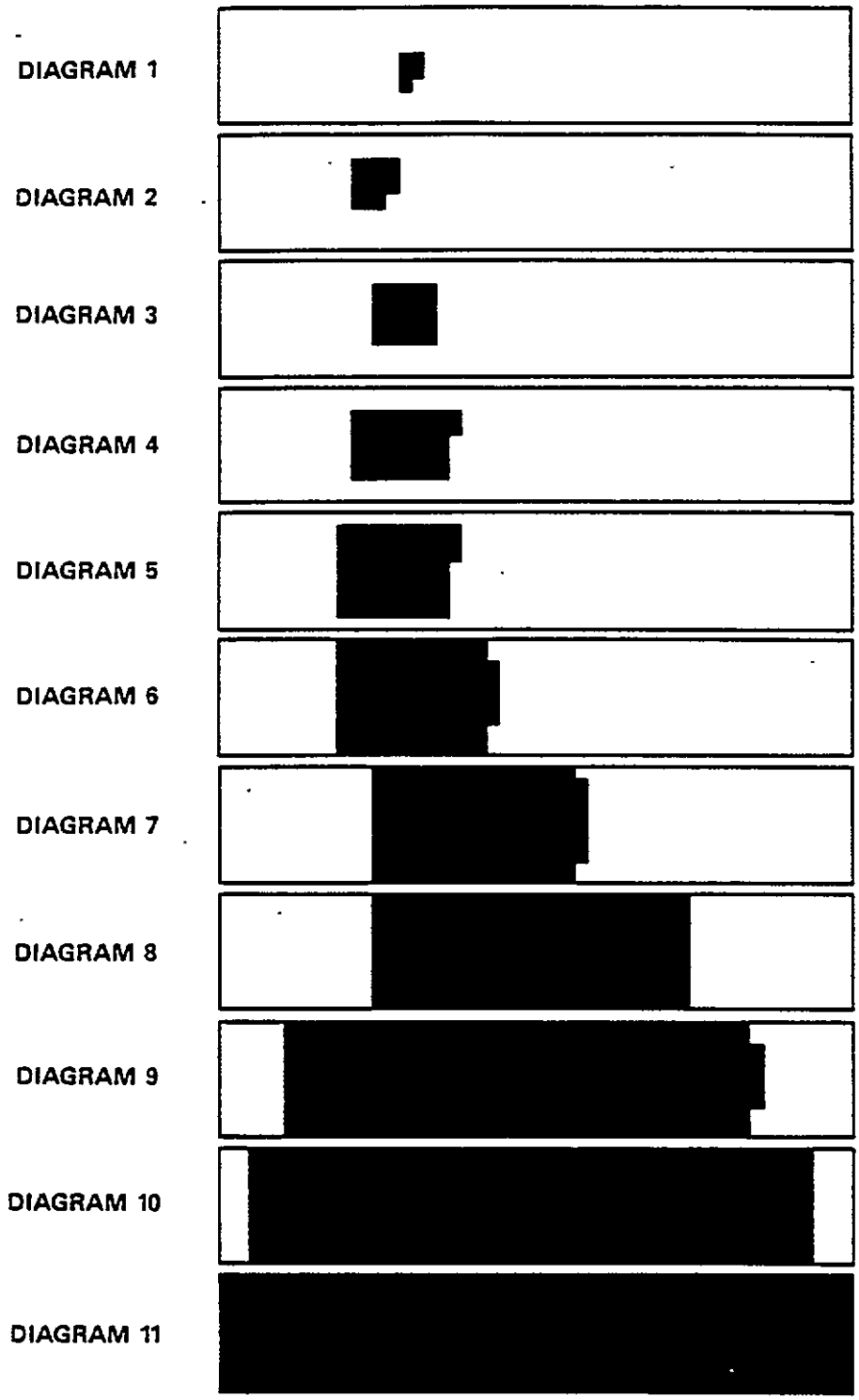


Fig. 1. Overall extent diagrams.

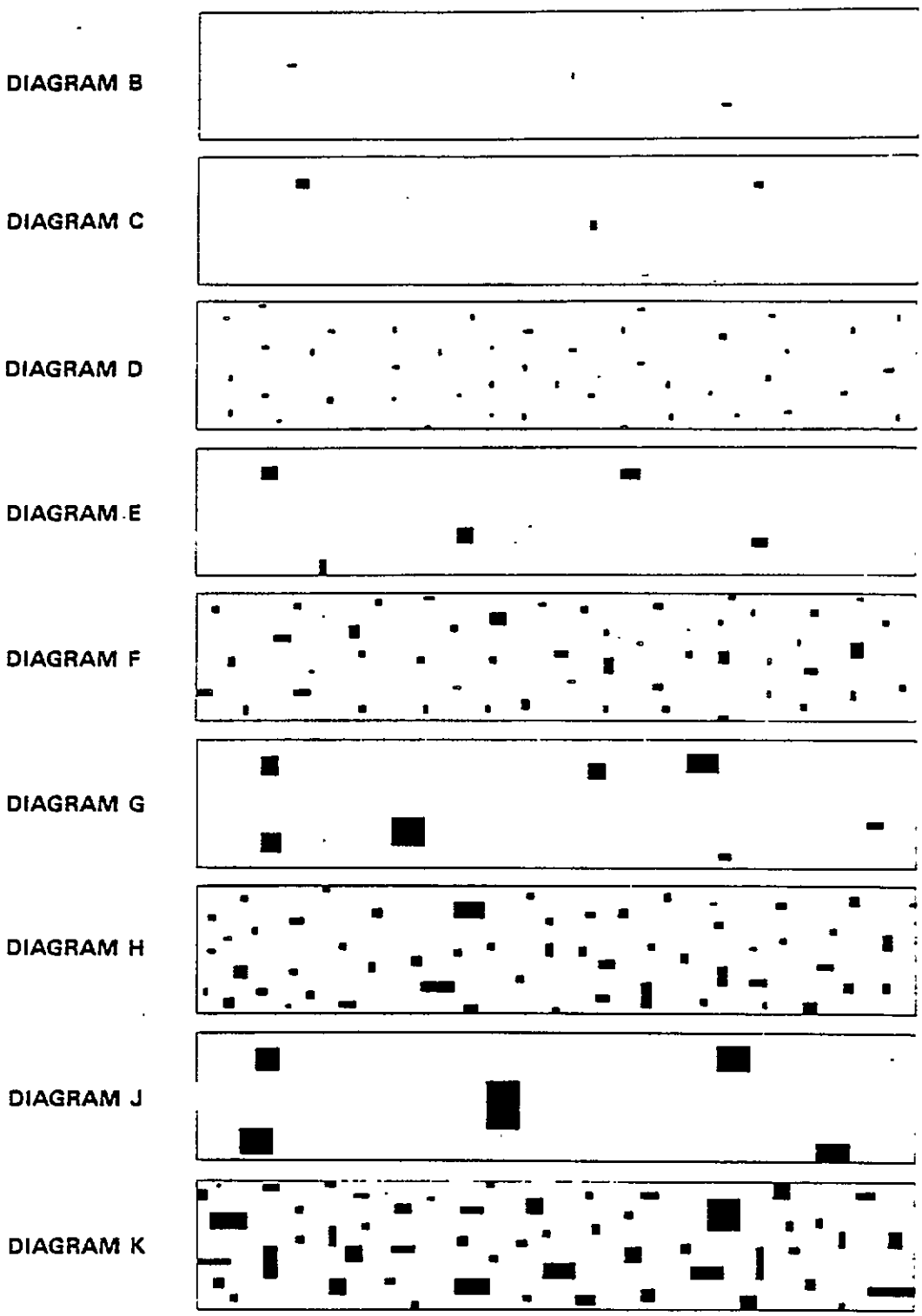


Fig. 2. Extent within affected area diagrams.

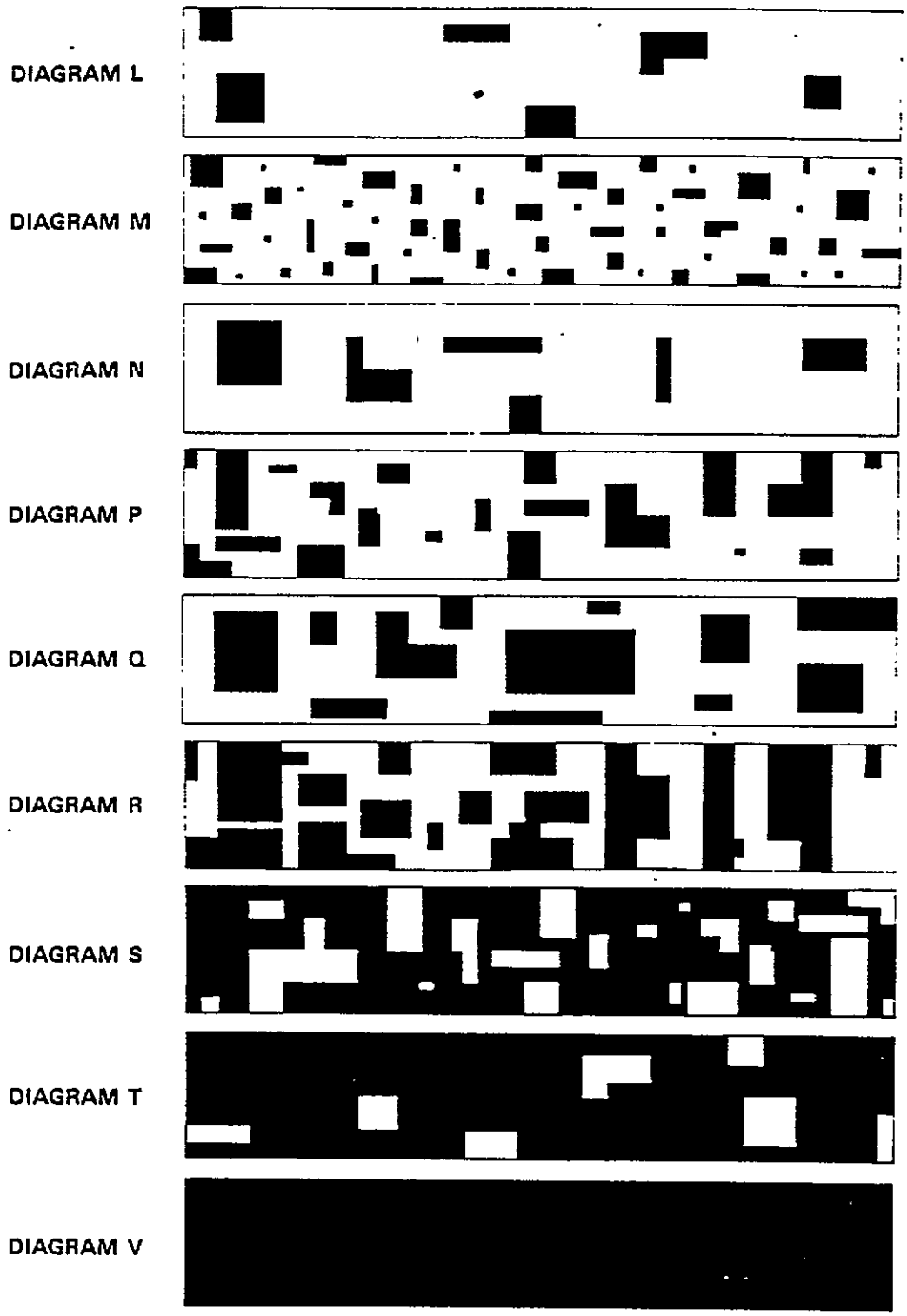
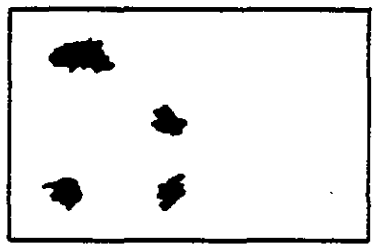


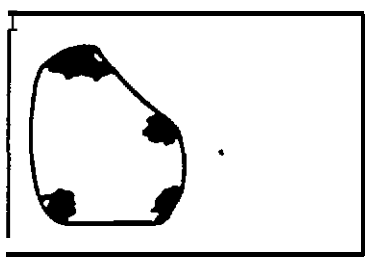
DIAGRAM L
DIAGRAM M
DIAGRAM N
DIAGRAM P
DIAGRAM Q
DIAGRAM R
DIAGRAM S
DIAGRAM T
DIAGRAM V

Fig. 3.

corrosion and paint failures. The 'OVERALL EXTENT DIAGRAMS' are used first co group all areas where a particular type of damage has occured into one contiguous block. The 'EXTENT WITHIN AFFECTED AREA DIAGRANS' are then used to identify the pattern of damage within that contiguous block. " For example, suppose you are inspecting for II.A (Corrosion General (see Figure 8)) and general corrosion appears distributed over the entire inspection area as shown by the black areas in the diagrams below.



The first step is to draw an imaginary line which would enclose all of the general corrosion. This enclosure should be as small as possible. Now select the diagram from the **OVERALL EXTENT DIAGRAMS which** most closely approximates the enclosed area with respect to the entire inspection area. Using the general corrosion example, the enclosed area (shaded area) would closely match Diagram 6.

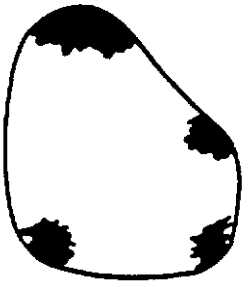


Enclosed Area

Diagram 6

Enter a '6' (for diagram 6) in the box next co II. A.1. OVERALL EXTENT in Figure 8.

The second step is to look at only the enclosed area and select the diagram from the EXTENT WITHIN AFFECTED AREA DIAGRAMS which most closely identifies the pattern of general corrosion in the enclosed area. In this example, Diagram N would be a good choice.



Enclosed Area

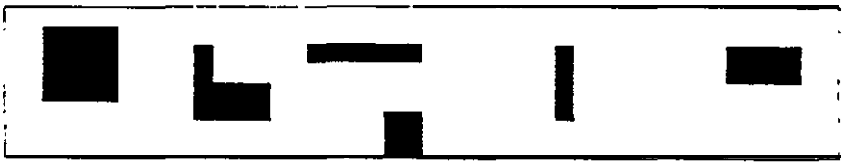


Diagram N

Enter an 'N' (for diagram N) in the box next to II.A. 1.A. EXTENT WITHIN AFFECTED AREA.

NOTE: Selection of diagrams is based on visual comparisons and therefore different inspectors may select different diagrams. However, the diagrams are designed to minimize these differences and enhance reproducibility.

3.2 FORMS OF MECHANICAL DAMAGE

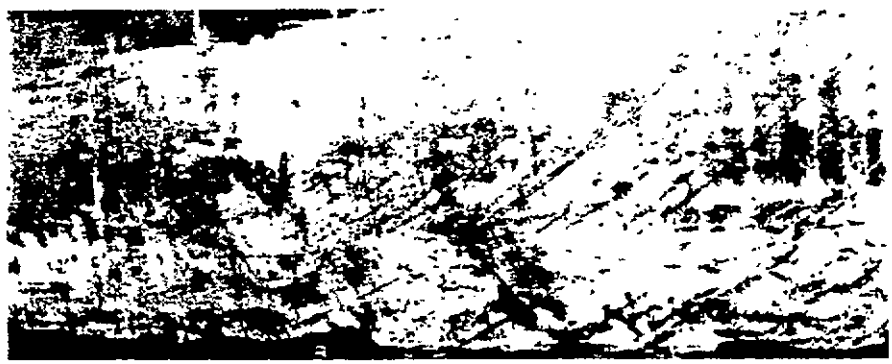
This reference standard (Figure 4) is a series of photographs used to identify the various forms of mechanical damage to a coating which can lead *to* corrosion.

3.3 TYPEs OF CORROSION

This reference standard (Figure 5) is a series of photographs used co show examples of general corrosion, pitting corrosion, pin-point corrosion, corrosion along welds, and ruse staining.

SCRAPING/
IMPACT

ANCHOR CHAINS/
ROPES/CABLES



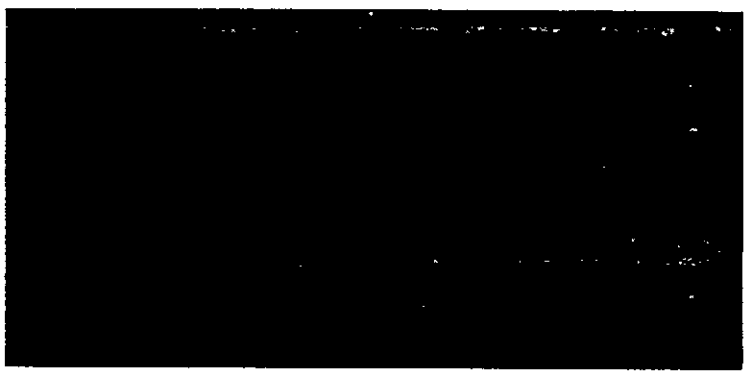
INTERNAL WELDS/
BURN MARKS

Fig. 4. Forms of mechanical damage.

GENERAL
CORROSION

PITTING
CORROSION

PIN-POINT
CORROSION



RUST STAINING

Fig. 5. Types of corrosion.

3.4 LEVELS OF DELAMINATION

This reference standard (Figure 6) is a series of diagrams which identifies the levels in a coating system where *delamination can occur.*

4. REQUIREMENTS

The inspector must know how to perform the following tests:

4.1 Calibrate and use a magnetic guage to measure dry film thickness.

4.2 Use pH paper properly.

4.3 Use a camera properly.

4.4 Recognize the various types of corrosion, and forms of paint failures (blistering, delamination, etc.).

5. PROCEDURS AND REPORTING

The inspection form consists of two pages to be completed by the inspector and four pages of reference standards. The first of the two pages to be completed by the inspector is shown in Figure 7. This form, which is self-explanatory, requests general information about the ship.

The second page of the inspection form to be completed by the inspector is shown. Detailed instructions for completing the form shown in Figure 8 are given below.

AREA NO. - The 'AREA NO.' is a code which is used to designate an area of the ship's deck or a piece of deck machinery. The purpose of the code is to postively identify the area being inspected so that a history of inspection data can be gathered. For sections of the ship other than decks and deck machinery (i,e., underwater hull, tanks and voids), it was possible to develop a general diagram of the ship section, divide

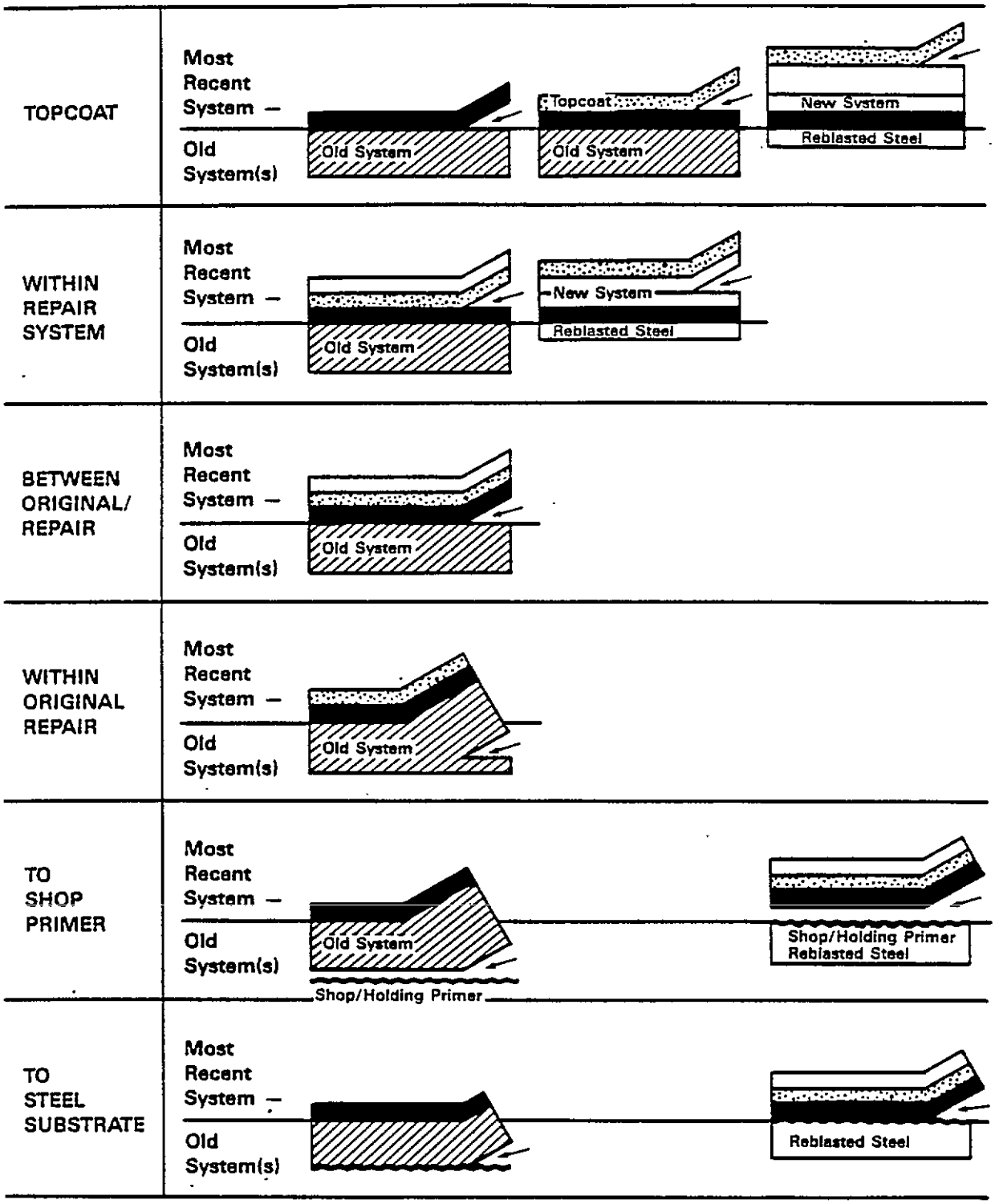


Fig. 6. Levels of delamination.

STANDARDIZED INSPECTION

A. NAME OF VESSEL AND HULL NUMBER _____

B. LOCATION (SHIPYARD) _____

C. IDENTIFICATION OF LAST COATING SYSTEM APPLIED (MANUFACTURER AND I. D.)

_____

D. **ADDITIONAL COMMENTS:**

_____

_____

_____

_____

_____

_____

_____

E. **INSPECTOR'S SIGNATURE** _____

F **INSPECTOR'S NAME (PRINT)** _____

G. **INSPECTION DATE** _____

Fig. 7.

DECKS/DECK MACHINERY

AREA NO. ______________ DATE______________

SHIP NAME ______________________________

HULL NUMBER______________________________

INSPECTOR'S NAME ______________________________

REQUIRED PHOTOGRAPHS
1. ENTIRE AREA
2. CLOSE-UP OF ALL DAMAGE

I. CORROSION
- A. GENERAL
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITHIN AFFECTED AREA . . . . . . ☐
- B. MECHANICAL DAMAGE
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITHIN AFFECTED AREA . . . . . ☐
  - 2. TYPE OF DAMAGE
    - A. SCRAPING/IMPACT . . . . ☐
    - B. ANCHOR CHAINS/ROPES/CABLES . . ☐
    - C. INTERNAL WELDS/BURNING . . . ☐
- C. PITTING CORROSION
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITHIN AFFECTED AREA . . . ☐
- D. PIN-POINT CORROSION
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITHIN AFFECTED AREA . . . . ☐
- E. RUST STAINING? . . . . Y N

II. PAINT CONDITION
- A. DELAMINATION
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITHIN AFFECTED AREA . . . . ☐
  - 2. TOPCOAT . . . . ☐
  - 3. WITHIN REPAIR SYSTEM . . . . ☐
  - 4. BETWEEN ORIGINAL/REPAIR . . . . ☐
  - 5. WITHIN ORIGINAL SYSTEM . . . . ☐
  - 6. TO SHOP PRIMER . . . . ☐
  - 7. TO STEEL SUBSTRATE . . . . ☐
  - 8. ORGANIC ODOR FROM DELAM. AREA? . . . . Y N
  - 9. SAMPLE TAKEN? . . . . Y N
- B. BLISTERING
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITHIN AFFECTED AREA . . . ☐
  - 2. SIZE (ASTM D714) . . . . ☐
  - 3. DENSITY (ASTM D714) . . . . ☐
  - 4. % BROKEN BLISTERS . . . . ☐
  - 5. ORGANIC ODOR IN BLISTERS? . . . . Y N
  - 6. BLISTERS CONTAIN WATER? . . . . Y N
    - A. pH . . . . ☐
  - 7. CORROSION UNDER BLISTERS? . . . . Y N

- C. CRACKING
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITHIN AFFECTED AREA . . . . . . ☐
- D. CHECKING
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITHIN AFFECTED AREA . . . . . . ☐
- E. FLAKING
  - 1. OVERALL EXTENT . . . . ☐
    - A. EXTENT WITIH AFFECTED AREA . . . . . ☐
  - 2. SEVERITY . . . . ☐
- F. SAGS OR CURTAINS? . . . . Y N
- G. CHALKING? . . . . Y N
- H. PRESENCE OF OIL/GREASE/SMOKE? . . . . Y N
- I. BLEEDING? . . . . Y N
- J. FADING? . . . . Y N
- K. EXCESSIVE WEAR/MECHANICAL DAMAGE
  - 1. NON-SKID AREAS . . . . Y N
  - 2. OTHER AREAS . . . . Y N
- L. KNIFE TEST
  - 1. ACCEPTABLE? . . . . Y N
    - IF 'N', MARK LEVEL(S) BELOW
    - A. TOPCOAT . . . . ☐
    - B. WITHIN REPAIR SYSTEM . . . . ☐
    - C. BETWEEN ORIGINAL/REPAIR . . . . ☐
    - D. WITHIN ORIGINAL SYSTEM . . . . . ☐
    - E. TO SHOP PRIMER . . . . . ☐
    - F. TO STEEL SUBSTRATE . . . . ☐

III. MEASURED PROPERTIES
- A. DRY FILM THICKNESS

_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_
_:_:_	_:_:_	_:_:_	_:_:_	_:_:_

  - 1. MORE DFT READINGS? . . . . Y N

Fig. 8.

the ship section in to logical inspection areas, and provide 'AREA NO.' codes for these inspection areas. However, decks and deck machinery vary so greatly between ship types that the development of a general diagram with logical inspection areas and 'AREA NO.' codes is not feasible. Therefore, it should be the responsibility of the orgsnization which authorizes the inspections to develop the ship diagram, logical inspection areas, and 'AREA NO.' codes and co make certain chat this same coding system is used during all subsequent inspections.

DATE - Enter the date of the inspection. If the inspection requires more than one day, enter the date the inspection is completed.

SHIP NAME - Enter the ship's name (Eg. USS TRENTON).

HULL NUMBER - Enter the hull number of the ship (Eg. LPD-14).

INSPECTOR'S NAME - The inspector should print his name.

REQUIRED PHOTOLWAPHS - For each inspection area, a photograph of the entire area is required. If the area is too large to capture in one photograph, the area should be divided into equal sized segments and each segment should be photographed. An individual close-up photograph of each damaged section in the inspection area is required. Each photograph should be marked with the Area No., Ship Name, and Date. Also, a 'size scale' should be cap cured in each photograph. This 'size scale' is a reference standard which would be used co determine the approximate size of the photographed ship area. For example, a 12 inch rule might be an appropriate size scale for a relatively small ship area.

1. CORROSION

The Inspector should distinguish between four types of corrosion and report each type separately. The four types of corrosion are:

1. GENERAL CORROSION - General corrosion, for the purposes of this inspection form, is all corrosion which is not covered in the mechanical damage, piecing corrosion, or pin-point corrosion sections below. Patches of common, ordinary rusting are classified as general corrosion.

2. MECHANICAL DAMAGE - Mechanical damage corrosion is corrosion that occurred because the paint was removed from the hull by some type of scraping or impact against the hull. With the paint removed and the steel hull exposed to sea water, corrosion occurred. Photographic examples of corrosion due to various forms of mechanical damage (i.e. grounding, scraping/impact, anchor chains/ropes, internal welds/burning and scrubbing) are shown in section 3.2.

3. PITTING CORROSION - Pitting corrosion is a more advanced form of localized corrosion. Pitting corrosion is characterized by visible indentations or pits which have penecraced into the steel hull surface. These pits distinguish between pitting corrosion and general corrosion, the latter being characterized by a layer of rust which does not penetrate locally into the surface but is more uniform in extent. A photographic example of pitting corrosion is shown in section 3.3.

4. PIN-POINT COSROSION - Pin-point corrosion is characterized by a pattern of small spots (pin-points) of rust. A photographic example of pin-point corrosion is shown in section 3.3.

A. GENERAL

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of general corrosion. If there is no general corrosion in this inspection area, enter the number '0' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in *section* 3.1), enter the letter of the diagram which most closely approximates the extent of general corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' (zero), Leave the EXTENT WITHIN AFFECTED AREA box blank.

B. MECHANICAL DAMAGE

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRANS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of corrosion due to mechanical damage. If there is no corrosion due to mechanical damage in this inspection area, enter the number '0' (zero), and Leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of corrosion due to mechanical damage within the affeced area. Remember, if the OVERALL EXTENT box above is marked with a ' ' (zero), Leave the EXTENT WITHIN AFFECTED AREA box blank.

2. TYPE OF DAMAGE - If corrosion due co mechanical damage has occurred, use the photographic examples in section 3.2 to identify the type of mechanical damage which has occurred. On the inspection form, mark an 'X' in the box. next to the type of damage (i.e. scraping/impact, internal welds/burn marks) which has occurred.

C. PITTING CORROSION

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of pitting corrosion. If there is no pitting corrosion in this inspection area, enter the number 'O' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of pitting corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

D. PIN-POINT CORROSION

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of pin-point corrosion. If there is no pin-point corrosion in this inspection area, enter the number 'O' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT wITHIN AFFECTED AREA DIAGMMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of pin-point corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank. ”

E. RUST STAINING? - Rust staining is a browish, rust-colored discoloration which occurs when loose rust particles are carried by water across a painted surface and are absorbed into the paint giving a brownish scain. It is important co distinguish between rust staining which is simply a discoloration, and corrosion which is a paint failure. If rust staining has occurred in the inSpection area, circle the ‘Y’. If no rust staining has occurred circle the 'N'.

II. PAINT CONDITION

A. DELAMINATION - Delamination is characterized by detachment of the coating from the substrate or by a layer separation between the coats of paint.

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of delamination. If there is no delamination in this inspection area, enter the number '0' (zero), and move down to B. BLISTERING.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter

of the diagram which most closely approximates the extent of delamination within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. TOPCOAT - Mark an 'X' in the box beside 'TOPCOAT' if top coat delamination has occurred. Top coat delamination has occurred if only the outermost coating has separated from all undercoats. A diagram of TOPCOAT delamination is shown in Section 3.4.

3. WITHIN REPAIR SYSTEM - Mark an 'X' in the box beside 'WITHIN REPAIR SYSTEM' if delamination has occurred between layers of the repair system **excluding delamination between the topcoat and the outermost undercoat** (remember, this is topcoat delamination). The repair system is defined as any coating system which is applied on top of the original coating system. Therefore, if the original coating system has not been overcoated, delamination within repair system is not possible. A diagram of delamination WITHIN REPAIR SYSTEM is shown in Section 3.4

4. BETWEEN ORIGINAL/REPAIR - Mark an 'X' in the box beside 'BETWEEN ORIGINAL/REPAIR' if delamination has occurred between the outermost coat of the original coating system and the innermost coat of the repair system. A diagram of delamination BETWEEN ORIGINAL/REPAIR is shown in Section 3.4.

5. WITHIN ORIGINAL SYSTEM - Mark an 'X' in the box beside 'WITHIN ORIGINAL SYSTEM' if delamination has occurred between any layers of the original coating system. A diagram of delamination WITHIN ORIGINAL SYSTEM *is* shown in Section 3.4.

6. TO SHOP PRIMER - Mark an 'X' in the box beside 'TO SHOP PRIMER' if delamination has occurred between the innermost coat of the original coating system and the shop primer. A diagram of delamination TO SHOP

PRIMER is shown in Section 3.4.

7. TO sTEEL SUBSTRATE - Mark an 'X' in the box beside 'TO STEEL SUBSTRATE' if all coatings have separated from the surface of the hull leaving the bare steel exposed. A diagram of delamination TO STEEL SUBSTRATE is shown in Section 3.4.

8. ORGANIC ODOR FROM DELAMINATION AREA? - The inspector should determine if there is an organic odor emanating from the delaminated area. If there is an odor from an organic solvent (such as MEK or hi-flash naphtha), circle the 'y'. If there is no organic odor, circle the 'N'.

9. SAMPLE TAKEN? If samples are taken, circle the 'Y'; if not, circle the 'N'. Samples may be taken by removing some of the delaminated paint chips and placing them into a small container. The container should be labelled with the AREA NO., SHIP NAME and NUMBER, DATE, and INSPECTOR'S NAME.

B. BLISTERING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3. 1), enter the number of the diagram which most closely approximates the overall extent of blistering. If there is no blistering in this inspection area, enter the number 'O' (zero), and move dowm co 'C. CRACKING'.

I a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of bliscering

within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. SIZE - Using the method described in ASTM D714, enter the number which most closely approximates the size of the largest blister in the inspection area.

3. DENSITY - Using the method described in ASTM D714, enter the number which most closely approximates the highest blister density in the inspection area.

4. % BROKEN BLISTERS - Visually approximate the percentage of broken blisters and enter that number in the box to the right. If none of the blisters are broken, enter a zero.

To complete the next three selections of the inspection, the inspector must break open a few of the blisters using a knife or other sharp object.

5. oRGANIC ODOR IN BLISTERS? - When the blisters are broken, the inspector should note whether the blisters contain liquid. If the blisters do contain liquid, the inspector should smell the Liquid to determine if the Liquid has an organic odor (i.e. ketone). If the liquid does have an organic odor, circle the “i’ next to 'ORGANIC ODUR IN BLISTERS?'. If there is no organic odor, or if the blisters do not contain Liquid circle the 'N'.

6. BLISTERS CONTAIN WATER? - If the blisters contain liquid and the liquid does not have an organic odor, circle the 'Y' next to 'BLISTERS CONTAIN WATER?'. If none of the blisters contain liquid, circle the 'N'.

A. pH - If YOU circled 'Y' in response to 'BLISTERS CONTAIN WATER?' , then determine the pH of the water using pH paper and enter the pH value in the box to the right of 'pH'.

7. CORROSION UNDER BLISTERS? - Look at the substrate beneath the blisters which have just been broken open. If any part of the substrate beneath these blisters is corroded, circle the 'Y' next to 'CORROSION UNDER BROKEN BLISTERS?'. If none of the substrate beneath these broken blisters is corroded, circle the 'N'.

C. CRACKING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and *instructions* for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of cracking. If there is no cracking in this inspection area, enter the number '0' (zero), and move down to 'D. CHECKING'.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the excent of cracking within the affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' *(zero), leave* the EXTENT WITHIN AFFECTED AREA box blank.

D. CHECKING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of checking. If there is no checking in this inspection area, enter the number '0' (zero), and move down to 'E. FLAKING'.

a ‘O’ (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

E. FLAKING

1. oVERALL EXTENT - Using the OVERALL EXTENT DIAGRAM (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of flaking. If there is no flaking in this inspection area, enter the number ‘O’ (zero), and move down to 'F. SAGS OR CURTAINS?'.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of flaking within the affecced area. Remember, if the OVERALL EXTENT box above is marked with a ‘O’ (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. SEVERITY - Use the photographic reference standard in ASTM D772 to determine the degree of flaking. Enter the number of the photographic reference standard (2,4,6, or 8) which most closely approximates the degree of flaking on the inspection surface.

F. SAGS OR CURTAINS? - Sags or curtains can occur on a vertical surface when paint is applied too thickly. Gravity will cause the paint to move down the vertical surface to form either a continuous ridge across the surface (curtain) or a running stream down the surface (sag). If either sags or curtains have occurred, circle the 'Y'. If there is no evidence of sags or curtains, circle the 'N'.

G. CHALKING? - Chalking is characterized by the presence of loose removable powder, evolved from the paint film itself, at or just beneath the surface.

Chalking may be detected by rubbing the fingertips across the film. If chalking is present, circle the 'Y'. If there is no evidence of chalking, circle the 'N'.

H. PRESENCE OF OIL/GREASE/SMOKE? - The inspector should examine the inspection area for the presence of oil or grease marks (usually the result of spills) and for smoke stains **(usually** the result of **smoke from exhaust stacks). If oil or grease marks or** smoke stains are present in the inspection area, the inspector should circle the 'Y'. Otherwise, the 'N' should be circled.

I. BLEEDING? - Bleeding is said to occur when the color of an undercoat (usually a darker color) extends or 'bleeds' through the surface of a topcoat (usually a lighter color). If bleeding has occurred in the inspection area, the inspector should circle the 'Y'. If there is no evidence of bleeding, the 'N' should be circled.

J. FADING? - Fading is defined as the loss of brightness or vividness of color. Fading is usually more apparent with darker colors. If fading has occurred in the inspection area, the inspector should circle the 'Y'. Otherwise, the 'N' should be circled.

K. EXCESSIVE WEAR/MECHANICAL DAMAGE ? - The inspector should examine the inspection area for signs of excessive wear or mechanical damage. Excessive wear is characterized by a 'wear path' through a coated area caused by heavy foot. or vehicular traffic over the same path. Mechanical damage is character-ized by scrapes or cuts through a coated area caused by dropping tools, dragging heavy equipment, etc.

1. NON-SKID AREAS - If excessive wear or mechanical damage has occurred on a non-skid surface in the inspection area, the inspector should circle the 'Y'. Otherwise, the 'N' should be circled.

2. **OTHER AREAS** - If excessive wear or mechanical damage has occurred on any surface which is not a non-skid surface, the inspector should circle the 'Y'. Otherwise the 'N' should be circled.

L. KNIFE TEST - Using a craftman's knife with a curved blade and holding the blade at a 30° angle to the substrate cut a narrow ribbon of coating from an undamaged portion of the inspection area.

1. ACCEPTABLE? - If the Cut portion of the coating ribbons or delaminates between layers, circle the 'Y'. If there is no evidence of ribboning or delamination between layers, circle the 'N'. If 'N' is circled, identify the delamination layer by marking the appropriate boxed (A-F) below.

A. TOPCOAT - Mark an 'X' in the box beside 'Topcoat' if top coat delamination has occurred. Top coat delamination has occurred if only the outermost coating has separated from all undercoats. A diagram of TOPCOAT delamination is shown in *section 3.4.*

B. WITHIN REPAIR SYSTEM - Mark an 'X' in the box beside 'WITHIN REPAIR SYSTEM' if delamination has. occurred between layers of the repair system excluding delamination between the topcoat and the outermost undercoat (remember, this is topcoat delamination). The repair system is defined as any coating system which is applied an top of the original coacing system. Therefore, if the original coating system has not been overcoated, delamination within repair system is not possible. A diagram of delamination WITHIN REPAIR SYSTEM is shown in Section 3.4.

C. BETwEEN ORIGINAL/REPAIR - Mark an 'X' in the box beside 'BETWEEN ORIGINAL/REPAIR' if delamination has occurred between the outermost coat of the original coating system and the innermost coat of the repair system. A diagram of delamination BETWEEN ORIGINAL/REPAIR is shorn in Section 3.4.

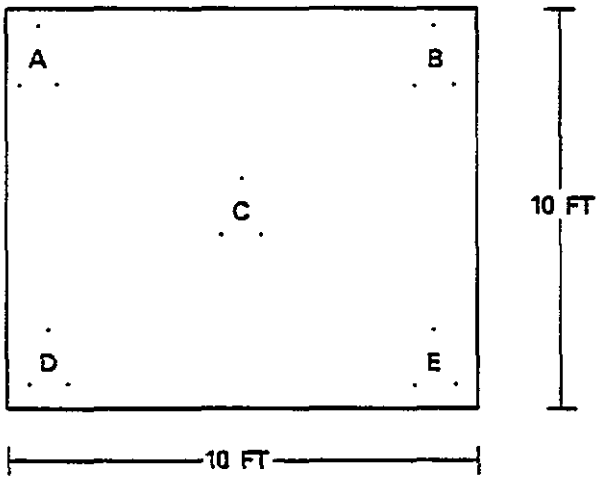
D. WITHIN ORIGINAL SYSTEM - Mark an 'X' in the box beside 'WITHIN ORIGINAL SYSTEM' if delamination has occurred between any layers of the original coating system. A diagram of delamination WITHIN ORIGINAL SYSTEM is show in Section 3.4.

E. TO SHOP PRIMER - Mark an 'X' in the box beside 'TO SHOP PRIMER' if delamination has occurred between the innermost coat of the original coating system and the shop primer. A diagram of delamination TO SHOP PRIMER is shown in Section 3.4.

F. TO STEEL SUBSTRATE - Mark an 'X' in the box beside 'TO STEEL SUB-STRATE' if all coatings have separated from the surface of the hull leaving the bare steel exposed. A diagram of de lamination TO STEEL SUBSTSATE is shown in Seccion 3.4.

IV. MEASURED PROPERTIES

A. Dry Film Thickness - Dry film thickness (DFT) measurements are to be made using a properly calibrated magnetic gage. Measurements and calibration are to be performed in accordance with SSPC-PA-2. Five separate spot measurements with three readings in each spot area are to be made in each 10 ft x 10 ft (100 square feet) area. This means that 15 individual readings will be made in the 100 square foot area (5 spot areas x 3 readings in each spot area = 15 total readings). The square below represents a 100 square foot area; the Letters (A, B, C, D and E) represent the 5 spot areas; and the dots represent where each individual DFT measurement should be made.



The five separate spot measurements (15 individual measurements) shall be made for each 100 square feet of area as followS:

(1) If the entire inspection area does not exceed 300 square feet (30 ft x 10 ft), each 100 square foot area shall be measured.

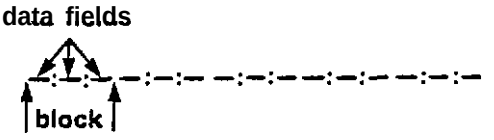
(2) If the entire inspection area does not exceed 1000 square feet (30 ft x 33 ft in), three 100 square foot areas shall be randomly selected and measured.

(3) If the entire inspection area exceeds 1000 square feet, the first 1000 square feet shall be measured as stated in (2) above and for each additional 1000 square feet of area or increment thereof, one 100 square foot area shall be randomly selected and measured.

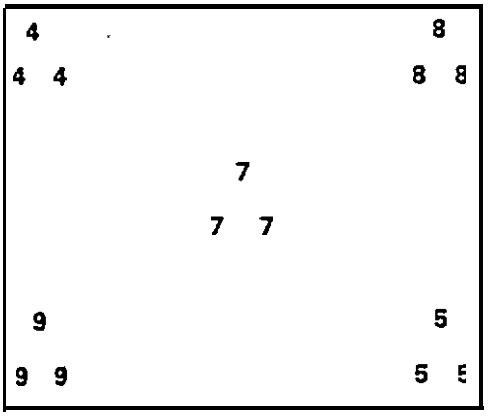
The separate SPOTS where OFT measurements are taken must be clean and dry with an intact coating undamaged by delamination, corrosion, etc. If a separate spot is not suitable for DFT measurements, move to the nearest suitable location. If the entire inspection area is not suitable for DFT measurements leave all boxes blank.

Each line on the inspection farm is intended to hold all of the readings for a 100 square foot area (15 readings). Notice chat each line under 'A. DRY

FILM THICKNSSS (MILS)' is composed of five blocks with each block separated by a space. Each block is composed of three data fields with each data field separated by a ':'.



As previously mentioned, for each 100 square foot area, the inspector should make five spot measurements with three individual *readings* being taken in each spot. Each data field will hold one of the three individuals readings; a block will therefore be equivalent to one of the five spot measurements. For example, suppose that the square below represents a 100 square foot area and that each number represents a DFT measurement (five spots, three measurements per spot).



Enter the readings onto the inspection form as shown below.

IV. MEASURED PROPERTIES

A. DRY FILM THICKNESS (MILS)

4:4:4 8:8 8 7 7 7 9.9:9 5:5 5

There are enough lines present on the inspection form to hold readings for a 11000 square foot inspection area.

If the inspection area is larger than 11000 square feet, circle the 'Y' next *to 'l.* MORE OFT READINGS?' On a separate sheet of paper, enter all of the additional readings. Also include the AREA NO. (of the inspection area), DATE, SHIP NAME, HULL NUMBER, and INSPECTOR'S NAME. If the inspection area is not larger **than** 11000 square feet, circle the 'N' next to 'l. MORE DFT READINGS?'

ASTM Designation F2502-D104

STANDARD METHOD FOR INFECTING THE COATING SYSTEM OF A SHIP'S TOPSIDE AND SUPERSTRUCTURE

1. SCOPE

1.1 This method describes a standard procedure for inspecting the coating system *of* a ship's topaide and superstructure. Included are a standard inspection form co be used for reporting the inspection data, a diagram which divides topside and superstructure individual inspection areas, and a series of diagrams which are used to report the extent of damage to the coating system. This method Is intended for use only by an experienced marine coating inspector.

2. APPLICABLE DOCUMENTS

2.1 ASTM Standards

- o 0714 Standard Method of Evaluating Degree of Blistering of Paints
- o D772 Standard Method of Evaluating Degree of Flaking (Scaling) of Exterior Paints

2.2 Steel Structures Painting Council (SSPC)

- o SSPC-PA-2 Measurement of Dry Paine Thickness with Magnetic Gages

3. REFERENCE STANDARDS

3.1 OVERALL EXTENT DIAGRAMS (Figure 1), EXTENT WITHIN AFFECTED AREA DIAGRAMS (Figures 2, and 3). The 'OVERALL EXTENT DIAGRAMS' and 'EXTENT WITHIN AFFECTED AREA DIAGRAMS' are used co report the area covered by different types of

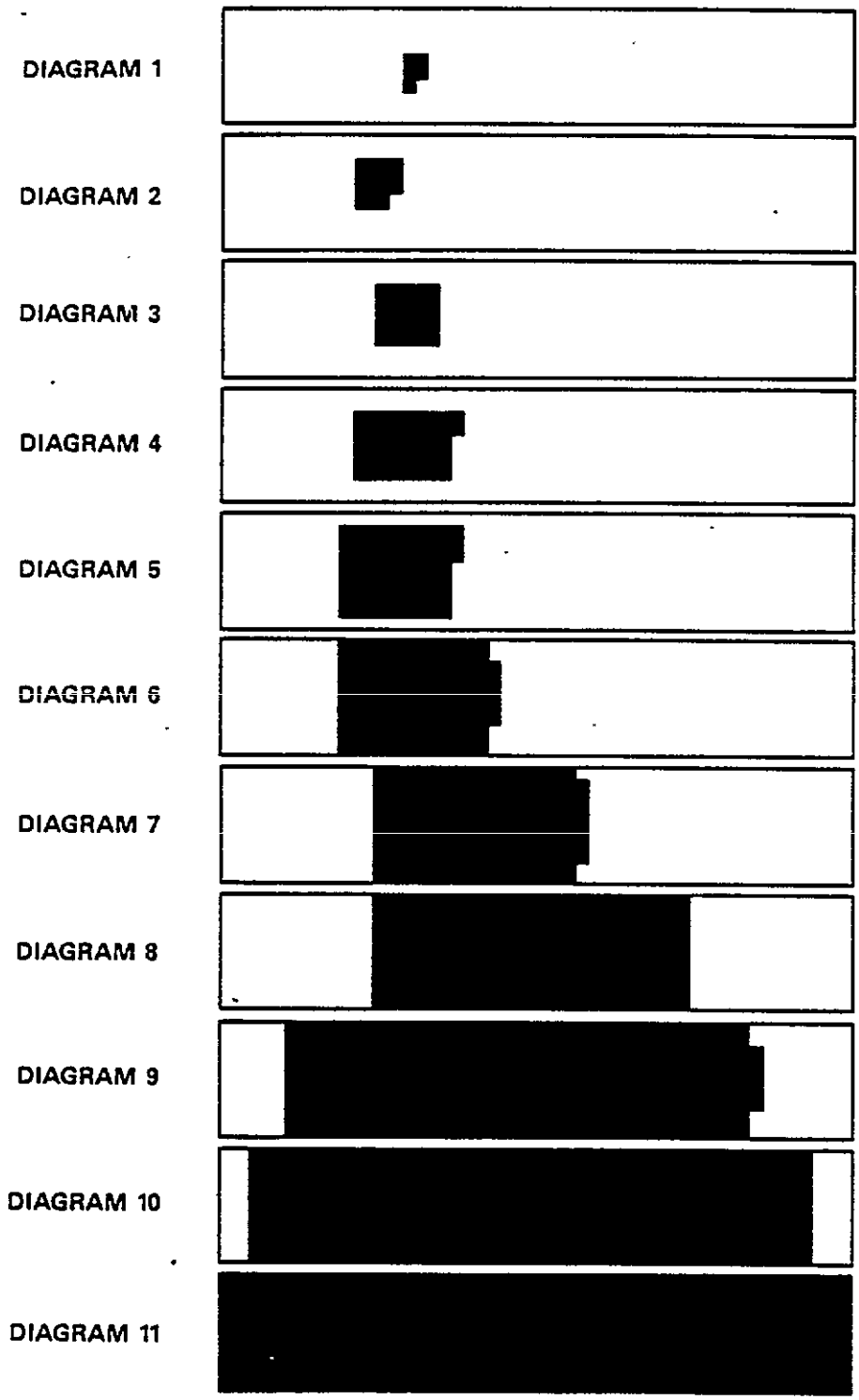


Fig. 1. Overall extent diagrams.

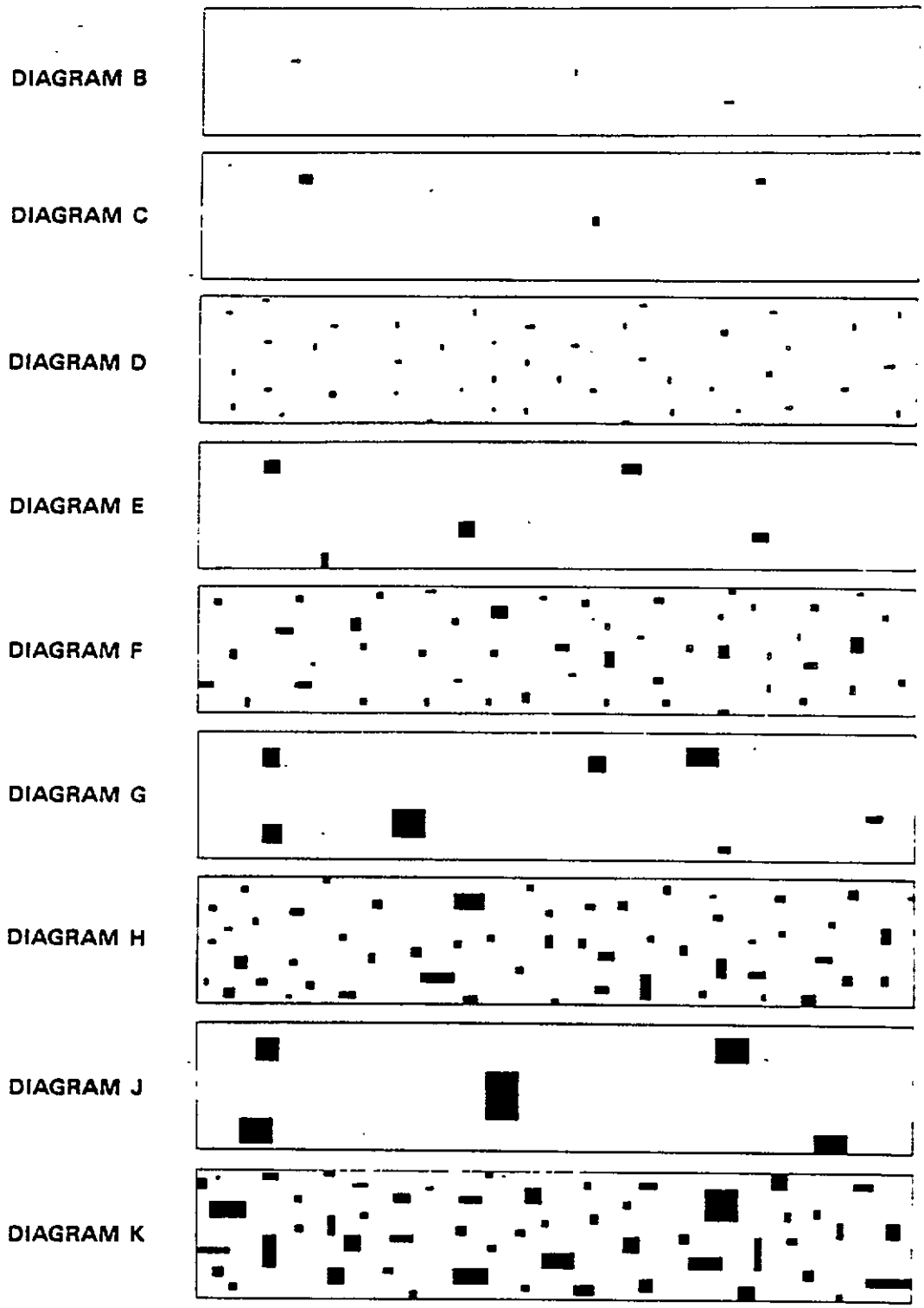


Fig. 2. Extent within affected area diagrams.

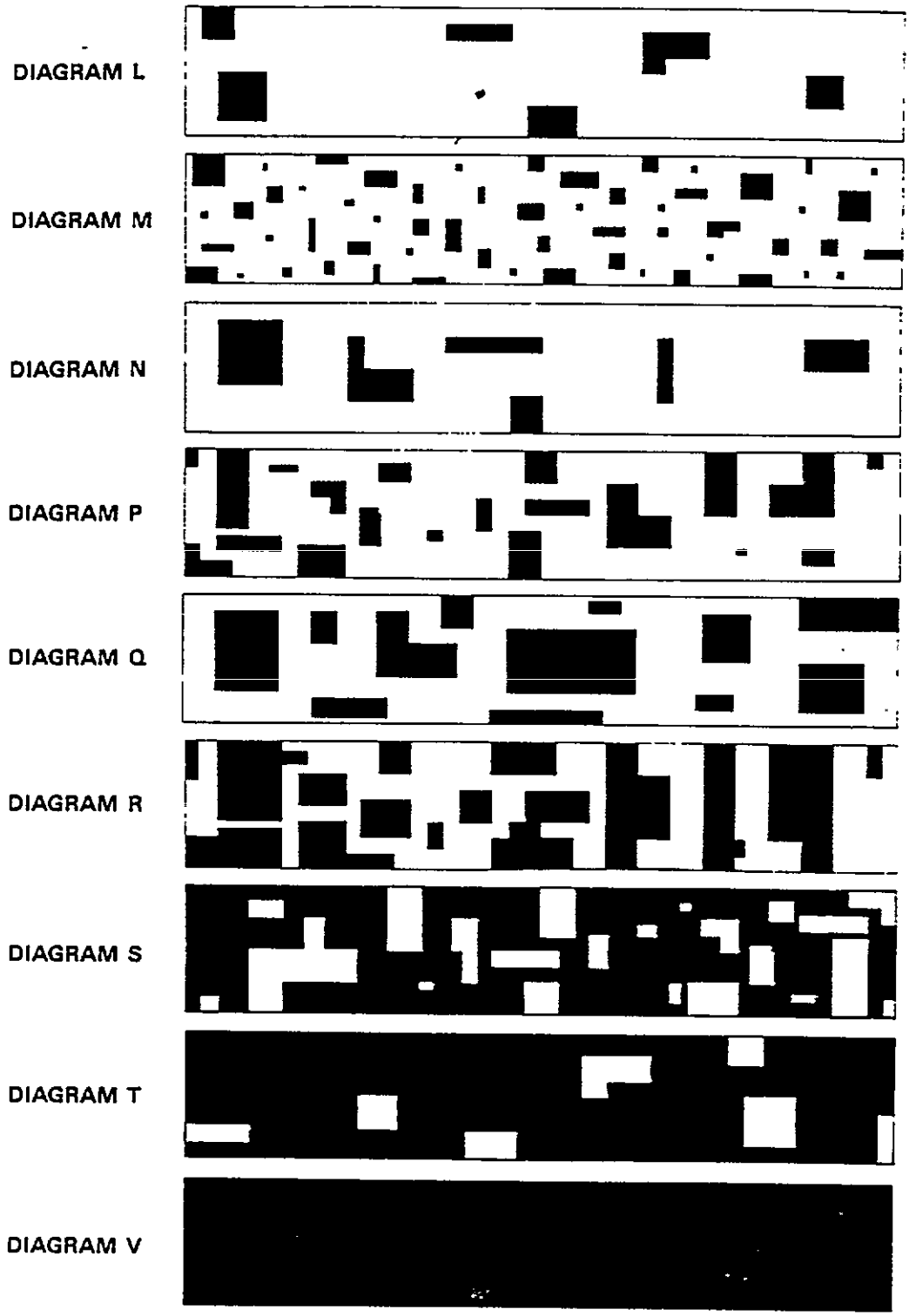
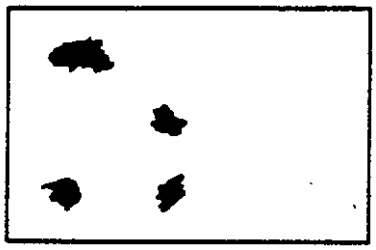


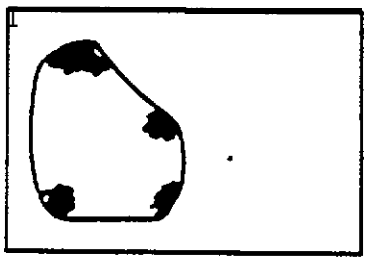
DIAGRAM L
DIAGRAM M
DIAGRAM N
DIAGRAM P
DIAGRAM Q
DIAGRAM R
DIAGRAM S
DIAGRAM T
DIAGRAM V

Fig. 3.

corrosion and paint failures. The 'OVERALL EXTENT l) DIAGRAMS' are used first to group all areas where a particular type of damage has occurred into one contiguous block. The 'EXTENT WITHIN AFFECTED AREA DIAGRAMS' are then used co identify the pattern of damage within that contiguous block. For example, suppose you are inspecting for 11. A (Corrosion General (see Figure 8)) and general corrosion appears **distributed over the entire inspection area as shown by the black areas in the diagrams below.**



The first seep is co draw an imaginary line which would enclose all of the general corrosion. This enclosure should be as small as possible. Now select the diagram from the OVERALL EXTENT DIAGRAMS which most closely approximates the enclosed area with respect co the entire Inspection area. Using the general corrosion example, the enclosed area (shaded area) would closely match Diagram 6.

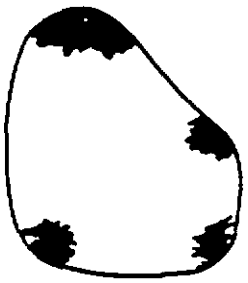


Enclosed Area

Diagram 6

Enter a '6' (for diagram 6) in the box next to 11. A. 1. OVERALL EXTENT in Figure 8.

The second step is to look at only the enclosed area and select the diagram from the EXTENT WITHIN AFFECTED AREA DIAGRAMS which most closely identifies the pattern of general corrosion in the enclosed area. In this example, Diagram N would be a good choice.



Enclosed Area

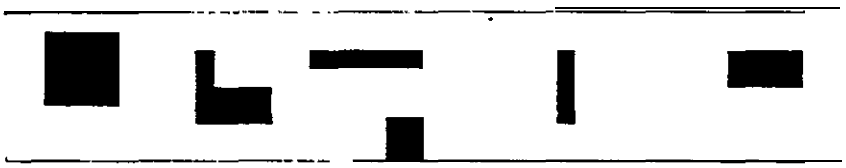


Diagram N

Enter an 'N' (for diagram N) in the box next to II.A.1.A. EXTENT WITHIN AFFECTED AREA.

NOTE: Selection of diagrams is baaed on visual comparisons and therefore different inspectors may select different diagrams. However, the diagrams are designed to minimize these differences and enhance reproducibility.

3.2 FORMS OF MECHANICAL DAMAGE

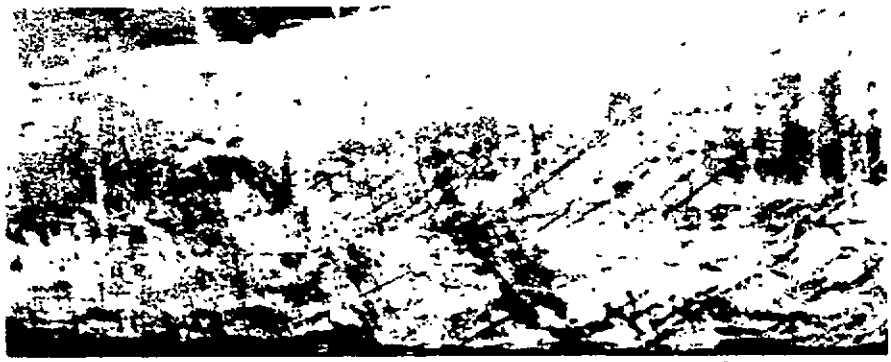
This reference standard (Figure 4) is a series of photographs used to identify the various forms of mechanical damage to a coating which can lead to corrosion

3.3 TYPES OF CORROSION

This reference standard (Figure 5) is a series of photographs used co show examples of general corrosion, pitting corrosion, pin-point corrosion, cavitation corrosion/coating undercutting and rust staining.

SCRAPING/
IMPACT

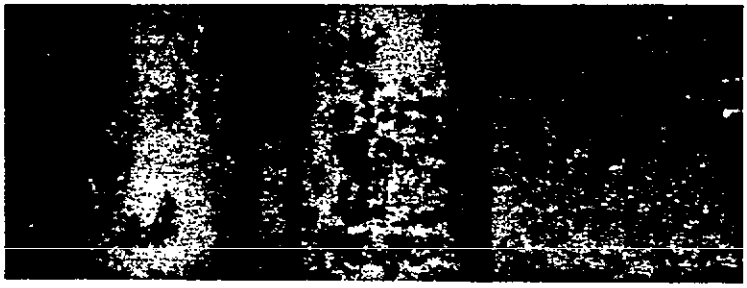
ANCHOR CHAINS/
ROPES/CABLES



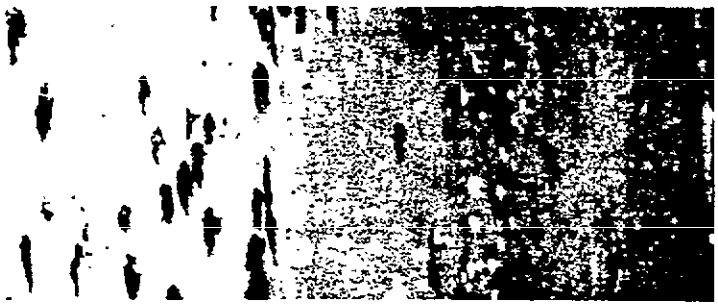
INTERNAL WELDS/
BURNING

Fig. 4. Forms of mechanical damage.

GENERAL CORROSION

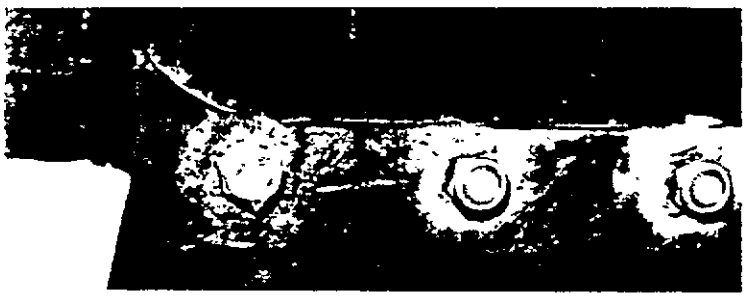


PITTING CORROSION



PIN-POINT CORROSION

GALVANIC CORROSION/ COATING UNDERCUTTING



RUST STAINING

Fig. 5. Types of corrosion.

3.4 LEVELS OF DELAMINATION

This reference standard (Figure ,6) is a series of diagrams which identifies the levels in a coating system where delamination can occur.

4. REQUIREMENTS

The inspector must know how to perform the following tests:

4.1 Calibrate and use a magnetic guage to measure dry film thickness.

4.2 Use pH paper properly.

4.3 Use a camera properly.

4.4 Recognize the various types of corrosion, and forms of paint failures (blistering, delamination, etc.).

4.5 Recognize the various ship areas as described in Figure 9.

5. PROCEDURE AND REPORTING

The inspection form consists of two pages to be completed by the inspector and four pages of reference standards. The first of the two pages *to be* completed by the inspector is showm in Figure 7. This form, which la self-explanatory, requests general information about the ship.

The second page of the Inspection form to be completed by the Inspector is shown in Figure 8. The topside and supecstructure is divided into three inspection areas. These three inspection areas are defined by the diagram in Figure 9. For each of the inspection areas delineated in Figure 9, the inspector is to complete a separate inspection form (shown in Figure 8). Therefore, for each complete inspection, the inspector must complete seven of the forms shown in Figure 8. Detailed instructions for completing the form

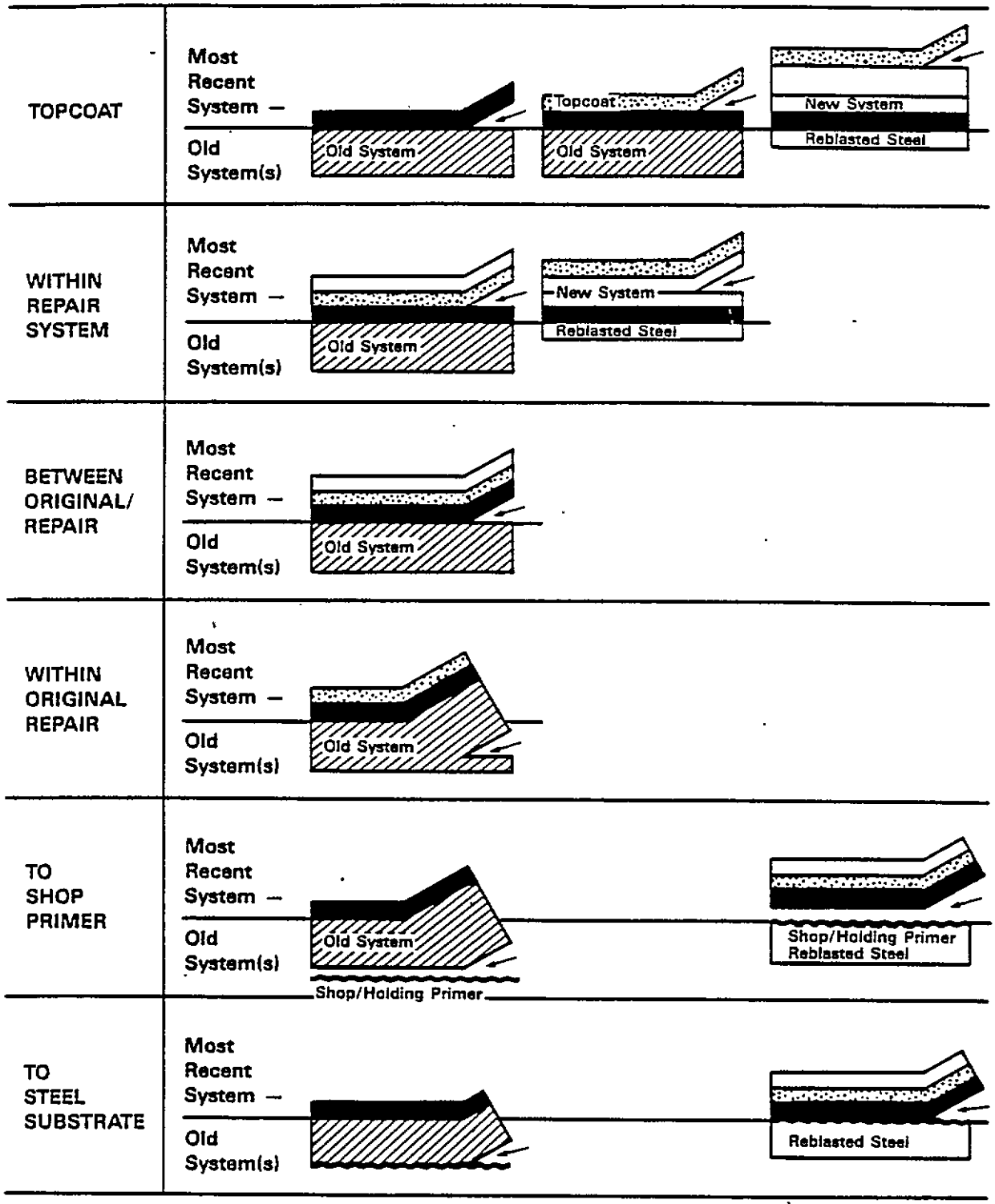


Fig. 6. Levels of delamination.

STANDARDIZED INSPECTION

A. NAME OF VESSEL AND HULL NUMBER _____

B. LOCATION (SHIPYARD) _____

C. IDENTIFICATION OF LAST COATING SYSTEM APPLIED (MANUFACTURER AND I. D.)

_____

D. ADDITIONAL COMMENTS:

_____

_____

_____

_____

_____

_____

_____

E . INSPECTOR'S SIGNATURE _____

F. INSPECTOR'S NAME (PRINT) _____

G. INSPECTION DATE _____

TOPSIDE

AREA NO._____ DATE_____

SHIP NAME _____

HULL NUMBER_____

INSPECTOR'S NAME _____

REQUIRED PHOTOGRAPHS
1. ENTIRE AREA
2. CLOSE-UP OF ALL DAMAGE

I. CORROSION
- A. GENERAL
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITHIN AFFECTED AREA .....
- B. MECHANICAL DAMAGE
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITHIN AFFECTED AREA .....
  - 2. TYPE OF DAMAGE
    - A. SCRAPING/IMPACT .....
    - B. ANCHOR CHAINS/ROPES (S1, P1 ONLY) ..
    - C. INTERNAL WELDS/BURNING .....
- C. PITTING CORROSION
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITHIN AFFECTED AREA .....
- D. PIN-POINT CORROSION
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITHIN AFFECTED AREA .....
- E. GALVANIC CORROSION/COATING UNDERCUTTING? ..... Y N
- F. RUST STAINING? ..... Y N

II. PAINT CONDITION
- A. DELAMINATION
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITHIN AFFECTED AREA .....
  - 2. TOPCOAT .....
  - 3. WITHIN REPAIR SYSTEM .....
  - 4. BETWEEN ORIGINAL/REPAIR .....
  - 5. WITHIN ORIGINAL SYSTEM .....
  - 6. TO SHOP PRIMER .....
  - 7. TO STEEL SUBSTRATE .....
  - 8. ORGANIC ODOR FROM DELAM. AREA? ..... Y N
  - 9 SAMPLE TAKEN? ..... Y N
- B. BLISTERING
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITHIN AFFECTED AREA .....
  - 2. SIZE (ASTM D714) .....
  - 3. DENSITY (ASTM D714) .....
  - 4. % BROKEN BLISTERS .....
  - 5. ORGANIC ODOR IN BLISTERS? ..... Y N
  - 6. BLISTERS CONTAIN WATER? ..... Y N
    - A. pH .....
  - 7. CORROSION UNDER BLISTERS? ..... Y N
- C. CRACKING
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITHIN AFFECTED AREA .....
- D. CHECKING
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITHIN AFFECTED AREA .....
- E. FLAKING
  - 1. OVERALL EXTENT .....
    - A. EXTENT WITIH AFFECTED AREA .....
  - 2. SEVERITY .....
- F. SAGS OR CURTAINS? ..... Y N
- G. CHALKING? ..... Y N
- H. PRESENCE OF OIL/GREASE/SMOKE? ..... Y N
- I. BLEEDING? ..... Y N
- J. FADING? ..... Y N
- K. KNIFE TEST
  - 1. ACCEPTABLE? ..... Y N
    - IF 'N', MARK LEVEL(S) BELOW
    - A. TOPCOAT .....
    - B. WITHIN REPAIR SYSTEM .....
    - C. BETWEEN ORIGINAL/REPAIR .....
    - D. WITHIN ORIGINAL SYSTEM .....
    - E. TO SHOP PRIMER .....
    - F. TO STEEL SUBSTRATE .....

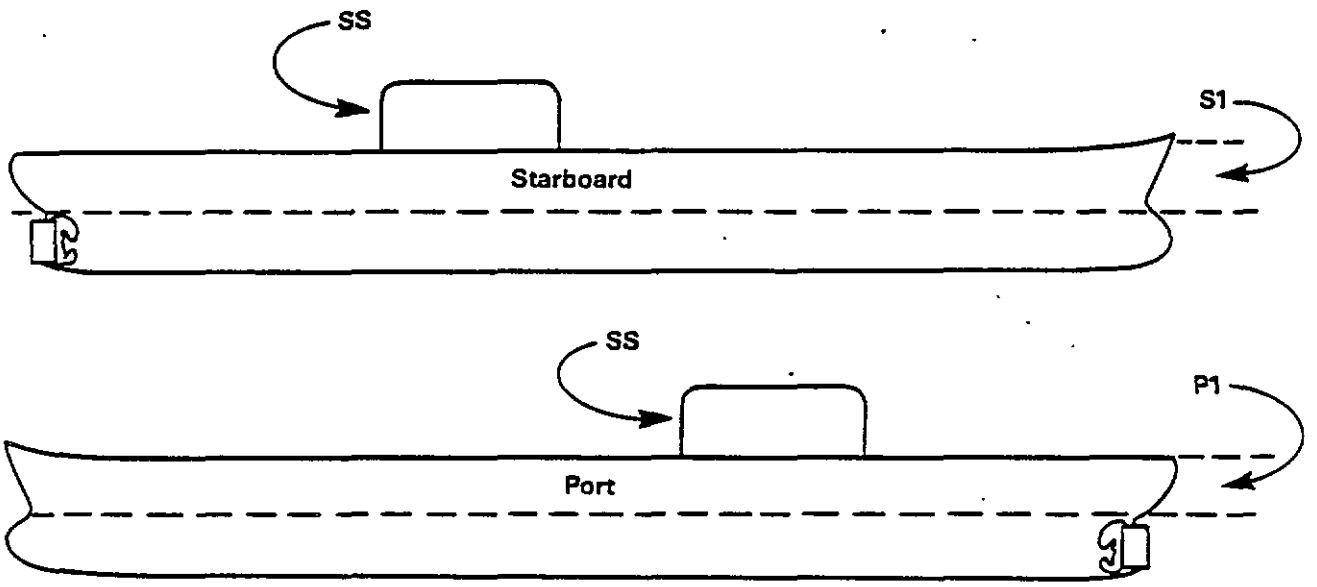
III. MEASURED PROPERTIES
- A. DRY FILM THICKNESS

—:—:— —:—:— —:—:— —:—:— —:—:—
(repeated 20 times)
  - 1. MORE DFT READINGS? ..... Y N

Fig. 8.

STANDARDIZED INSPECTION
TOPSIDE AND SUPERSTRUCTURE

The Topside is Defined as the Area From the Maximum Load Line to the Rail



Inspection Areas:

The topside and superstructure are divided into three distinct inspection areas as follows:

- **P1 – Port Topside**
- **P2 – Starboard Topside**
- **P3 – Superstructure**

Each inspection area is to be inspected for all the properties listed on the accompanying inspection form (Fig. 8).

Fig. 9: Standardized inspection, topside and superstructure.

shown in Figure 8 are given below.

AREA NO. - The topside/superstructure is divided into three inspection areas (see Figure 9). Enter the code for the area being inspected. For example, enter "Pi" for the port side, "S1" for the starboard side and "SS" for the superstructure.

DATE - Enter the date of the inspection. If the inspection requires more than one day, enter the date the inspection is completed.

SHIP NAME - Enter the ship's name (Eg. USS TRENTON).

HULL NUMBER - Enter the hull number of the ship (Eg. LPD-14).

INSPECTOR'S NAME - The inspector should print his name.

REQUIRED PHOTOGRAPHS - For each inspection area, a photograph of the entire area is required. If the area is coo large to capture in one photograph, the area should be divided into equal sized segments and each segment should be. photographed. An individual close-up photograph of each damaged section in the inspection area is required. Each photograph should be marked with the Area No., Ship Name, and Date. Also, a 'size scale' should be captured in each photograph. This 'size scale' is a reference standard which would be used to determine the approximate size of the photographed ship area. For example, a 12 inch rule might be an appropriate size scale for a relatively small ship area.

I. CORROSION

The inspector should distinguish between four types of corrosion and report each type separately. The four types of corrosion are:

1. GENERAL CORROSION - General corrosion, for the purposes of this inspection form, is all corrosion which is not covered in the mechanical damage, pitting corrosion, or pin-point corrosion sections below. Patches of common. ordinary rusting are classified as general corrosion.

2. MECHANICAL DAMAGE - Mechanical damage corrosion is corrosion that occurred because the paint was removed from the hull by some type of scraping or impact against the hull. With the paint, removed and the steel hull exposed to sea water, corrosion occurred. Photographic examples of corrosion due to various forms of mechanical damage (i.e. grounding, scraping/impact, anchor chains/ropes, internal welds/burning and scrubbing) are shown in section 3.2.

3. PITTING CORROSION - Pitting corrosion is a more advanced form of localized corrosion. Pitting corrosion is characterized by visible indentations or pits which have penetrated into the steel hull surface. These pits distinguish between pitting corrosion and general corrosion, the latter being characterized by a layer of rust which does not penetrate Locally in co the surface but is more uniform in extent. A photographic example of pitting corrosion is shown in section 3.3.

4. PIN-POINT CORROSION - Pin-point corrosion is characterized by a pattern of small spots (pin-points) of rust. A photographic example of pin-point corrosion is shown in section 3.3.

A. GENERAL

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of general corrosion. If there is no general corrosion in this inspection area, enter the number '0' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of general corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

B. MECHANICAL DAMAGE

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of corrosion due to mechanical damage. If there is no corrosion due to mechanical, damage in this inspection area, enter the number '0' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

"a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of corrosion due to mechanical damage within the affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. TYPE OF DAMAGE - If corrosion due to mechanical damage has occurred, use the photographic examples in section 3.2 to identify the type of mechanical damage which has occurred. On the inspection form, mark an 'X' in the box next to the type of damage (i.e. scraping/impact, internal welds/burn marks) which has occurred.

C. PITTING CORROSION

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use In Section 3.1), enter the number of the diagram which most closely approximates The overall excent of piecing corrosion. If there is no pitting corrosion in this inspection area, enter the number '0' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of piecing corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

D. PIN-POINT CORROSION

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which moat closely approximates the overall extent of pin-point corrosion. If there is no pin-point corrosion in this inspection area, enter the number '0' (zero), and leave the next box (EXTENT WITHIN AFFECTED AREA) blank.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagram and instructions for use in section 3.1), enter the letter

of the diagram which most closely approximates the extent of pin-point corrosion within the affected area. Remember, if the OVERALL EXTENT box above is marked with a '0' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

E. GALVANIC CORROSION/COATING UNDERCUTTING? - Galvanic corrosion /coating undercutting occurs most frequently in situations where dissimilar metals are joined (i. e., near posts, mounts, bolts and especially when an aluminum superstructure is mounted on a steel hull). Galvanic corrosion/coating undercutting is characterized by corrosion which may begin beneath undamaged coating. The corrosion undercuts and lifes the coating as it progresses. If galvanic corrosion/coating undercutting is present, the inspector should circle the "Y". Otherwise the "No" should be circled.

F. RUST STAINING? - Rust staining is a brownish, rust-colored discoloration which occurs when loose ruse particles are carried by water across a painted surface and are absorbed into the paint giving a brownish stain. It is important co distinguish between rust staining which is simply a discoloration, and corrosion which is a paint failure. If rust staining has occurred in the inspection area, circle the 'Y'. If no ruse staining has occurred circle the 'N'.

II. PAINT CONDITION

A. DELAMINATION - Delamination is characterized by detachment of the coating from the substrate or by a layer separation between the coats of paint.

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of delamination. If there is no delamination in this Inspection area, enter the number '0' (zero), and reeve down to B. BLISTERING.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT wITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of delamination within the affected area. **Remember, if the** OVERALL EXTENT box above is **marked** with a '0' (zero), leave the EXTENT wITHIN AFFECTED AREA box blank.

2. TOPCOAT - Mark an 'X' in the box beside 'TOPCOAT' if cop coat delamination has occurred. Top coat delamination has occurred if only the outermost coating has separated from **all** undercoats. A diagram of 'TOPCOAT delamination is shown in Section 3.4.

3. WITHIN REPAIR SYSTEM - Mark an 'X' in the box beside 'WITHIN REPAIR SYSTEM' if delamination has occurred between layers of the repair system excluding delamination between the topcoat and the outermost undercoat (remember, this is topcoat delamination). The repair system is defined as any coating system which is applied on top of the original coating system. Therefore, if the original coating system has not been overcoated, delamination within repair system is not possible. A diagram of delamination WITHIN REPAIR SYSTEM is shown in Seccion 3.4

4. BETWEEN ORIGINAL/REPAIR - Mark an 'X' in the box beside 'BETWEEN ORIGINAL/REPAIR' if delamination has occurred between the outermost coat of the original coating system and the innermost coat of the repair system. A diagram of delamination **BETWEEN** ORIGINAL/REPAIR is ***show in*** Section 3.4.

5. WITHIN ORIGINAL SYSTEM - Mark an 'X' in the box beside 'WITHIN oRIGINAL SYSTSM' if delamination has occurred **between any layers of the** original **coating system.** **A** diagram of delamination WITHIN ORIGINAL SYSTEM is show in Section 3.4.

6. TO SHOP PRIMER - Mark an 'X' in the box beside 'TO SHOP PRIMER' if delamination has occurred between the Innermost coat of the original coating system and the shop primer. A diagram of delamination TO SHOP PRIMER is shown in Section 3.4.

7. TO STEEL SUBSTRATE - Mark an 'X' in the box beside 'TO STEEL SUBSTRATE' if all coatings have separated from the surface of the hull leaving the bare steel exposed. A diagram of delamination TO STEEL SUBSTRATE *is* shown in Section 3.4.

8. ORGANIC ODOR FROM DELAMINATION AREA? - The inspector should determine if there is an organic odor emanating from the delaminated area. If there is an odor from an organic solvent (such as MEK or hi-flash naphtha), circle the 'Y'. If there is no organic odor, circle the 'N'.

9. SAMPLE TAKEN? If samples are taken, circle the 'Y' ; if not, circle the 'N'. Samples may be taken by removing some of the delaminated paint chips and placing them in co a small container. The container should be labelled with the AREA NO. , SHIP NAME and NUMBER, DATE, and INSPECTOR'S NAME.

B. BLISTERING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of blistering. If there is no blistering in this Inspection area, enter the number '0' (zero), and move down co 'C. CARCKING'.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and Instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of blistering

within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. SIZE - Using the method described in ASTM D714, enter the number which most closely approximates the size of the largest blister in the inspection area.

3. DENSITY - Using the method described in ASTM D714, enter the number which most closely approximates the highest blister density in the inspection area.

4. % BROKEN BLISTERS - *visually* approximate the percentage of broken blisters and enter that number in the box to the right. If none of the blisters are broken, enter a zero.

To complete the next three selections of the inspection, the inspector must break open a few of the blisters using a knife **or** ocher sharp object.

5. ORGANIC ODOR IN BLISTERS? - When the blisters are broken, the inspector should note whether the blisters contain liquid. If the blisters **do contain** liquid, the inspector should small the liquid to determine if the liquid has an organic odor (i.e. ketone). If the liquid does have an organic odor, circle the 'Y' next to 'ORGANIC ODOR IN BLISTERS?'. If there is no organic odor, or if the blisters do not contain Liquid **circle** the 'N'.

6. BLISTERS CONTAIN WATER? - If the blisters contain liquid and the liquid does not **have an organic odor.** circle the 'Y' next to 'BLISTERS CONTAIN WATER?'. If none of the blisters contain liquid, circle the 'N'.

A. pH - If you circled 'Y' in response to 'BLISTERS CONTAIN WATER?', then determine the pH *of* the water using pH paper and enter the pH value in the box co the right of 'pH'.

7. CORROSION UNDER BLISTERS? - Look at the substrate beneath the blisters which have just been broken open. If any part of the substrate beneath these blisters is corroded, circle the 'Y' next to 'CORROSION UNDER BROKEN BLISTERS?'. If none of the substrate beneath these broken blisters is corroded, circle the 'N'.

C. CRACKING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of cracking. If there is no cracking in this inspection area, enter the number 'O' (zero), and move down to 'D. CHECKING'.

a. 'EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of cracking within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

D. CHECKING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of checking. If there is no checking in this inspection area, enter the number '0' (zero), and move down to 'E. FLAKING'.

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams and instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of checking within the affected area. Remember, if the OVERALL EXTENT box above is marked with

a '0' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

E. FLAKING

1. OVERALL EXTENT - Using the OVERALL EXTENT DIAGRAMS (diagrams and instructions for use in Section 3.1), enter the number of the diagram which most closely approximates the overall extent of flaking. If there is no flaking in this inspection area, enter the number '0' (zero), and move down to 'F. SAGS OR CURTAINS?' .

a. EXTENT WITHIN AFFECTED AREA - Using the EXTENT WITHIN AFFECTED AREA DIAGRAMS (diagrams aced instructions for use in section 3.1), enter the letter of the diagram which most closely approximates the extent of flaking within the affected area. Remember, if the OVERALL EXTENT box above is marked with a 'O' (zero), leave the EXTENT WITHIN AFFECTED AREA box blank.

2. SEVERITY - Use the photographic reference standard in ASTM D772 co determine the degree of flaking. Enter the number of the photographic reference standard (2,4, 6, or 8) which most closely approximates the degree of flaking on the inspection surface.

F. SAGS OR CURTAINS? - Sags or curtains can occur on a vertical surface when paint is applied too thickly. Gravity will cause the paint co move down the vertical surface to form either a continuous ridge across the surface (curtain) or a running stream down the surface (sag). If either sags or curtains have occurred, circle the 'Y'. If there is no evidence of sags or curtains, circle the 'N'.

G. CHALKING? - Chalking is characterized by the presence of loose removable powder, evolved from the paint film itself, at or just beneath the surface.

Chalking may be detected by rubbing the fingertips across the film. If chalking is present, circle the 'Y'. If there is no evidence of chalking, circle the 'N'.

H. PRESENCE OF OIL/GREASE/SMOKE? - The inspector should examine the inspection area for the presence of oil or grease marks (usually the resul~ of spills) and for smoke stains (usually the result of smoke from exhaust stacks). If oil or grease marks or smoke stains are present in the inspection area, the inspector should circle 'Y'. Otherwise, the 'N' should be circled.

I. BLEEDING? - Bleeding is said co occur when the color of an undercoat (usually a darker color) extends or 'bleeds' through the surface of a topcoat (usually a lighter color). If bleeding has occurred in the inspection area, the inspector should circle the 'Y'. If there is no evidence of bleeding, the 'N' should be-circled.

J. FADING? - Fading is defined as the loss of brightness or vividness of color. Fading is usually more apparent with darker colors. If fading has occurred in the inspection area, the inspector should circle the 'Y'. Otherwise, the 'N' should be circled.

K. KNIFE TEST - Using a craftman's knife with a curved blade and holding the blade at a 30° angle to the subatrate cut a narrow ribbon of coating from an undamaged portion of the inspection area.

1. ACCEPTABLE? - If the cut portion of the coating ribbons or delaminates between layers, circle the 'Y'. If there is to evidence of ribboning or delamination between layers, circle the 'N'. If 'N' is circled, identify the delamination layer by marking the appropriate boxed (A-F) below.

A. TOPCOAT - Mark an 'X' in the box beside 'Topcoat' if cop coat

delamination has occurred. Top coat delamination has occurred if only the outermost - coating has separated from all undercoats. A diagram of TOPCOAT delamination is shown in Section 3.4

B. WITHIN REPAIR SYSTEM - Mark an 'X' in the box beside 'WITHIN REPAIR SYSTEM' if delamination has occurred between layers of the repair system excluding delamination between the topcoat and the outermost undercoat (remember, this is topcoat delaminatiom). The repair system is defined as any coating system which is applied on top of the original coating system. Therefore, if the original coating system has not been overcoated, delamination within repair system is not possible. A diagram of delamination WITHIN REPAIR SYSTEM is shown in Section 3.4

C. BETWEEN ORIGINAL/REPAIR - Mark an 'X' In the box beside 'BETWEEN ORIGINAL/REPAIR' if delamination has occurred between the outermost coat of the original coating system and the innermost coat of the repair system. A diagram of delamination BETWEEN ORIGINAL/REPAIR is shown in Section 3.4

D. WITHIN ORIGINAL SYSTEM - Mark an 'X' in the box beside 'WITHIN ORIGINAL SYSTEM' if delamination has occurred between any layers of the original coating system. A diagram of delamination WITHIN ORIGINAL SYSTEM is shown in Section 3.4

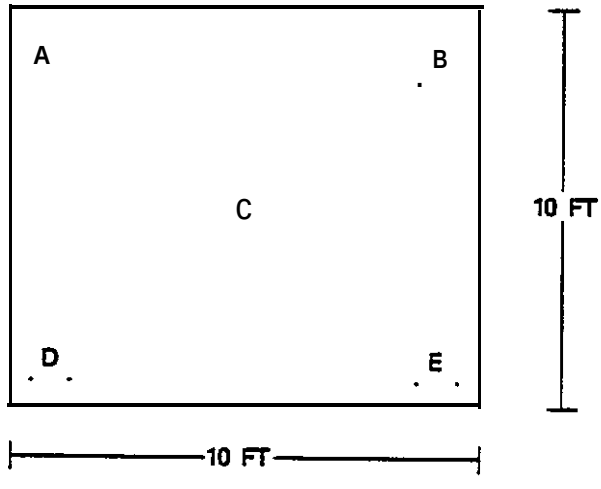
E. TO SHOP PRIMER - Mark an 'X' in the box beside 'TO SHOP PRIMER' if delamination has occurred between the innermost coat of the original coating system and the shop primer. A diagram of delamination TO SHOP PRIMER is shown in Section 3.4

F. TO STEEL SUBSTRATE

the bare steel exposed. A diagram of delamination TO STEEL SUBSTRATE is shown in Section 3.4

IV. MEASURED PROPERTIES

A. Dry Film Thickness - Dry film thickness (DFT) measurements are to be made using a properly calibrated magnetic gage. Measurements and calibration are co be performed in accordance. with SSPC-PA-2. Five separate spot measurements with three readings in each spot area are to be made in each 10 ft x 10 ft (100 square feet) area. This means chat 15 individual readings will be made in the 100 square foot area (5 spot areas x 3 readings in each spot area = 15 total readings). The square below represents a 100 square foot area; the letters (A, B, C, D and E) represent the 5 spot areas; and the dots represent where each individual DFT measurement should be made.



The five separate spot measurements (15 Individual measurements) shall be made for each 100 square feet of area as follows:

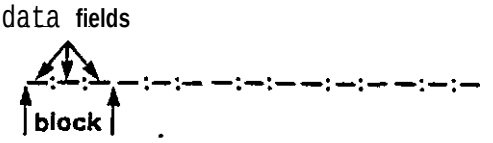
(1) If the entire inspection area does not exceed 300 square feet (30 ft x 10 ft), each 100 square foot area shall be measured.

(2) If the entire inspection area does not exceed 1000 square feet (30 ft x 33 ft 4 in), three 100 square foot areas shall be randomly selected and measured.

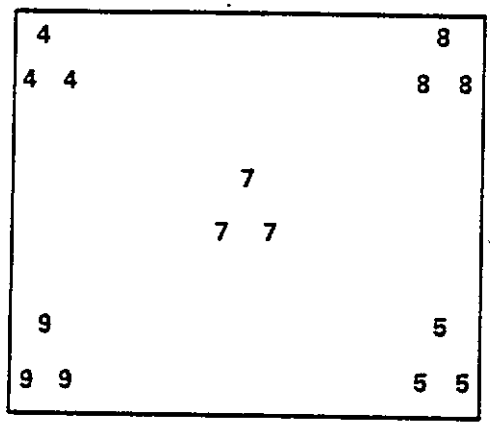
(3) If the entire inspection area exceeds 1000 square feet, the first 1000 square feet shall be measured as stated in (2) above and for each additional 1000 square feet of area or increment thereof, one 100 square foot area shall be randomly selected and measured.

The separate spots where DFT msasurements are taken must clean and dry with an intact coating undamaged by delamination, corrosion, etc. If a separate spot is not suitable for DFT measurements, move to the nearest suitable location. If the entire inspection area is not suitable for DFT measurements leave all boxes blank.

Each line on the inspection is intended to hold all of the readings for a 100 square foot area (15 readings). Notice that each line under 'A. DRY FILM THICKNESS (MILS)' is composed of five blocks with each block separated by a space. Each block is composed of three data fields with each data field separated by a ':'.



As previously mentioned, for each 100 square foot area, the inspector should make five spot measurements with three individual readings being taken in each spot. Each data field will hold one of the three individuals readings; a block will therefore be equivalent co one of the five spot measurements. For example, suppose that the square below repreaents a 100 square foot area and that each number represents a DFT measurement (five spots, three measurements per spot).



Enter the readings onto the Inspection form as shown below.

IV. MEASURED PROPERTIES

A. DRY FILM THICKNESS (MILS)

4 4 4 8 8 8 7 7 7 9 9 9 5 5 5

There are enough lines present on the inspection form to hold readings for a 16000 square foot inspection area.

If the inspection area is larger than 16000 square feet, circle the 'y' next to '1. MORE DFT READINGS?' On a separate sheet of paper, enter all of the additional readings. Also include the AREA NO. (of the inspection area), DATE, SHIP NAME, HULL NUMBER, and INSPECTOR'S NAME. If the inspection area is not larger than 16000 square feet, circle the 'N' next to '1. MORE DFT READINGS?'

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